The Engineer.

Established 1856. Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 28, ESSEX ST., STRAND, LONDON, W.C. 2.

VOL. CLII.—No. 3951] LONDON: FRIDAY EVENING, OCTOBER 2, 1931 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES.

The Agent, Eastern BENGAL RAILWAY, Calcutta, invites TENDERS for :—
MACHINERY for KANCHRAPARA WORKSHOPS.
Forms of Tender available from the DIRECTOR-GENERAL, India Store Department, Belvedere-road, Lambeth, London, S.E. 1, at a fee (which will not be returned) of 5s.
Tenders must provide for the delivery of the stores C.I.F. Calcutta and for payment in India in rupees. Any Tender which does not comply with these conditions will not be considered.
Tenders must be sent direct to the AGENT, Eastern Bengal Railway, Calcutta, to reach him not later than the 11th November, 1931. 7598

University College of South WALES AND MONMOUTHSHIRE.
COLEG PRIFATHROFAOL DEHEUDIR CYMRU A MYNWY.
A SPECIAL CLASS in METALLOGRAPHY, suitable for persons engaged in Metallurgy, Mining and Engineering, will be held on SATURDAY MORNING at the UNIVERSITY COLLEGE, Newport-road, Cardiff.
The CLASS will COMMENCE on OCTOBER 10th, 1931.
Particulars may be obtained from the undersigned.
D. J. A. BROWN,
Registrar.
University College, Cathays Park, Cardiff, September, 1931. 7585

University of London.
A COURSE of FIVE LECTURES, with lantern illustrations, on "THE MEASUREMENT OF LIGHT: ITS BASIS AND ITS SIGNIFICANCE," will be given by Mr. E. C. CRITTENDEN (Chief of the Electrical Division in the Bureau of Standards, Department of Commerce, Washington), at the INSTITUTION OF ELECTRICAL ENGINEERS (Victoria Embankment, W.C. 2), on OCTOBER 16th, 21st, 23rd, 26th, and 28th, at 5.30 p.m. At the first Lecture the chair will be taken by Mr. C. C. Paterson, O.B.E. (President of the Institution of Electrical Engineers).
ADMISSION FREE, WITHOUT TICKET.
S. J. WORSLEY,
7599 Academic Registrar.

ARTHUR WILLIAM BARTLETT Deceased.
PURSUANT to the TRUSTEE ACT 1925 Section 27.
Notice is Hereby Given, that all creditors and other persons having any debts, claims or demands against the Estate of Arthur William Bartlett late of 53 Burlington-avenue Kew Gardens in the County of Surrey and of 59 and 60 Chancery-lane in the County of London, Engineer's Draughtsman (who died on the 3rd day of July 1931 and whose will was proved by Ernest Edward Bartlett and Harold Richard Bartlett the Executors therein named, in the principal Registry of the Probate Division of His Majesty's High Court of Justice, on the 18th day of September 1931) are hereby required to send particulars in writing of their debts, claims or demands to us, the undersigned, as Solicitors for the said Executors on or before the 12th day of December 1931. And Notice is Hereby Given, that at the expiration of that time the said Executors will proceed to distribute the Assets of the said Testator among the parties entitled thereto having regard only to the debts, claims and demands of which they shall then have had notice; and that they will not be liable for the Assets or any part thereof so distributed to any person or persons of whose debt, aim or demand they shall not then have had notice.
Dated this 30th day of September 1931.
UPPERTON PERKIN & CO.,
14, Lincoln's Inn-fields, London, W.C. 2.
7609 Solicitors to the said Executors.

NOTICE TO FOREMEN.

The National Foremen's Asso-CIATION is an Association of Foremen formed to represent them on all questions affecting their supervisory interests.
For full particulars apply, GENERAL SECRETARY, 95, Belgrave-road, Westminster, S.W. 1.
7608

Bombay, Baroda and Central INDIA RAILWAY COMPANY.
The Directors are prepared to receive up to Noon of Friday, 23rd October, TENDERS for the SUPPLY of :
1. LOCOMOTIVE BOILERS.
2. BEARING PLATES.
Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 20s. each for No. 1 and 10s. each for No. 2 (which will not be returned).
The Directors do not bind themselves to accept the lowest or any Tender.
S. G. S. YOUNG,
Secretary.
Offices: The White Mansion, 91, Petty France, Westminster, S.W. 1, 30th September, 1931. 7603

Limerick Harbour.
PORT DEVELOPMENT SCHEME.
DOCK EXTENSION.
The Limerick Harbour Commissioners, at their meeting to be held Monday, November 9th, 1931, will be prepared to consider TENDERS from competent engineering contractors for the CONSTRUCTION of an EXTENSION to the existing WET DOCK at Limerick, in accordance with the plans and specification prepared by the undersigned.
The quantities of the principal items are approximately as follows :—
280,000 Cubic Yards (more or less) Earth Excavation;
16,000 Cubic Yards (more or less) Rock Excavation;
27,000 Cubic Yards (more or less) Mass Concrete;
114,000 Cubic Yards (more or less) Dredging and Excavation;
650 Tons (more or less) Steel Sheet Piling;
Dock Gates, Pontoons, and Operating Gear.
Copies of the plans, conditions of contract, specification and schedule of quantities may be obtained upon application to the Harbour Engineer, Engineer's Office, Docks, Limerick.
Applications must be accompanied by a deposit of £10 10s., which deposit will be returned only on the receipt of a bona fide Tender, not subsequently withdrawn, with the return of all the documents.
Sealed Tenders, endorsed "Tender, Dock Extension," must be lodged with the Secretary, Limerick Harbour Commissioners, O'Connell-street, Limerick, not later than Noon on Saturday, November 7th, 1931.
The Commissioners do not bind themselves to accept the lowest or any Tender.
T. F. O'SULLIVAN, B.E., M. Inst. C.E.I.,
Harbour Engineer.
Engineer's Office, Docks, Limerick. 7591

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.
ARRANGED FOR CARD INDEXING.

Press-Tool and Fixture Design No. VII. (P. 340)
(H. C. LANE.) THE ENGINEER, 2 - 10 - 31.

Shipping, Engineering and Machinery Exhibition at Olympia—No. IV. (P. 341)
THE ENGINEER, 2 - 10 - 31.

Railway Organisation in France. (P. 341)
THE ENGINEER, 2 - 10 - 31.

British Association Centenary Meeting No. II. (P. 354)
THE ENGINEER, 2 - 10 - 31.

The Faraday Exhibition—No. II. (P. 348)
THE ENGINEER, 2 - 10 - 31.

A Petrol-Driven Rail Coach—No. II. (P. 359)
THE ENGINEER, 2 - 10 - 31.

Prophecy and Progress. (P. 353)
THE ENGINEER, 2 - 10 - 31.

The Institute of Metals—No. III. (P. 358)
THE ENGINEER, 2 - 10 - 31.

Iron and Steel Institute. (P. 346)
THE ENGINEER, 2 - 10 - 31.

INDEX TO ADVERTISEMENTS, PAGE 63.

PUBLIC NOTICES.

Metropolitan Water Board.
DISPOSAL OF SURPLUS PLANT.
The Metropolitan Water Board invite TENDERS for the DISMANTLING, PURCHASE and REMOVAL as Surplus Plant of 10 CORNISH BOILERS, 6 Vickers MECHANICAL STOKERS and GEARING, 3 Bull ENGINES and PUMPS, and 11 Spare CORNISH PUMP VALVES, in the Bull Engine-house at their Hampton Works, Upper Sunbury-road, Hampton-on-Thames.
The plant may be inspected at the above-mentioned works between the hours of 10 a.m. and 4 p.m. (Saturdays, 10 a.m. and 12 noon), on application to the Resident Engineer.
Forms of Tender, containing particulars of the plant and conditions of sale, may be obtained from the Chief Engineer by personal application at the offices of the Board (Room 155) or upon forwarding a stamped addressed sack envelope.
Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed "Tender for Surplus Plant," must be delivered to the offices of the Board (Room 122) not later than 11 a.m. on Monday, 19th October, 1931.
The Board do not bind themselves to accept the highest or any Tender.
G. F. STRINGER,
Clerk of the Board.
Offices of the Board, 173, Rosebery-avenue, E.C. 1, 28th September, 1931. 7582

River Ouse (Yorks) Catchment BOARD.
LAND DRAINAGE ACT, 1930.
ENGINEER'S DEPARTMENT.
APPLICATIONS are INVITED to fill the following POSTS :—
DISTRICT ENGINEERS (2). Salary £400 p.a.
ENGINEERING ASSISTANT. Salary £300 p.a.
DRAUGHTSMAN. Salary £200 p.a.
Applicants for the above posts must have had experience in either the construction, maintenance, or design of River and Land Drainage Works, such as River Walls and Embankments, Bridges, Arterial Drains, Sluices, Locks, Pumping Stations, &c.
Forms of application may be obtained from me on sending a foolscap stamped addressed envelope to this office.
Applications, on the official form, accompanied by copies of not more than three recent testimonials, should be received by me by first post on Saturday, the 17th October, 1931.
Canvassing will disqualify.
F. M. PARMER,
Clerk to the Board.
Central Bank Chambers, Infirmary-street, Leeds. 7590

PUBLIC NOTICES.

The River Avon (Bristol) CATCHMENT BOARD.
APPOINTMENT OF ENGINEER.
APPLICATIONS are INVITED from Civil Engineers with experience in Land Drainage for the POSITION of ENGINEER to the Board.
The gentleman appointed will be required to devote the whole of his time to the duties of the appointment. The salary will be at the rate of £500 per annum, and office and staff will be provided by the Board. At the discretion of the Board the salary may be increased by increments to £600 per annum. There will be an allowance for use of car for purposes of inspection, &c.
Applications, giving experience, qualifications, date of birth and present salary and accompanied by not more than three recent testimonials, must be forwarded to me on or before Wednesday, the 14th day of October, 1931. The envelope should be sealed and endorsed "Engineer."
Canvassing will be regarded as a disqualification.
FRANK M. HART,
Acting Clerk to the Board.
The Council House, Bristol. 7547

The Manchester Steam Users' ASSOCIATION.
For the Prevention of Steam Boiler Explosions and for the Attainment of Economy in the Application of Steam, 20, QUAY-STREET, DEANSGATE, MANCHESTER.
Founded 1854 by SIR WILLIAM FAIRBAIRN.
Certificates of Safety issued under the Factory and Workshops Act, 1901. Compensation for Damages and Liabilities paid in case of Explosions. Engines and Boilers Inspected during construction. 6762

SITUATIONS OPEN.

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

TO ADVERTISERS UNDER BOX NUMBERS IN THIS CLASSIFICATION.
For the benefit of applicants, the Proprietors are prepared to insert brief notices that vacancies are filled, upon receipt of notifications from the Advertisers. These notices (limited to one line) will be free of charge and co-operation is asked for.

A FIRST-CLASS MAN, with Qualifications for Taking Charge of Machining and Erecting Shops. Knowledge of Woodworking Machinery essential.—Apply, RECEIVER and MANAGER, A. Ransome and Co., Ltd., Stanley Works, Newark-on-Trent. 7595 A

SITUATIONS OPEN.

A LARGE GENERAL ENGINEERING FIRM is desirous of consolidating its activities in the manufacture of Chemical Plant and REQUIRES the SERVICES of an experienced TECHNICAL COMMERCIAL ENGINEER with good knowledge and connection in the chemical trade.
Applicants must give full particulars, including salary required.
Address, 7545, The Engineer Office. 7545 A

GRINDING WHEEL SALESMAN.—An Experienced GRINDING SALESMAN is REQUIRED to reside in the North of England.—Apply, with particulars of age, education, training, and experience, ALFRED HERBERT, Ltd., Coventry. 7589 A

REPRESENTATIVE REQUIRED by Old-established Crane Firm in Yorkshire. Must have had thorough engineering training, and possess tactful and pleasing personality which will impress prospective customers. Age 35 to 40. Give full particulars of experience and state age and salary expected.
Address, 7592, The Engineer Office. 7592 A

DRAUGHTSMAN (Mechanical Engineering) REQUIRED by provincial firm, one with experience in Laundry Machinery preferred. Give full particulars, including age, experience, salary.—Address, P1558, The Engineer Office. P1558 A

DRAUGHTSMAN, Young, with Experience in Structural and General Building Work for Construction Dept. of Electricity Supply Company; £3 to £3 10s. per week, according to qualifications.—Address, 7593, The Engineer Office. 7593 A

ENGINEER DRAUGHTSMAN REQUIRED for design of complete Refrigeration Plants. Experience of Land and Ship Installations essential. Capable of making all calculations and supervising work through drawing-office.
State age, experience, and salary required.
HASLAM and NEWTON, Ltd., Derby. P1539 A

A SKILLED MOULDERS' FOREMAN for General Foundry Work. Only live up-to-date men will be considered.—Apply, RECEIVER and MANAGER, A. Ransome and Co., Ltd., Stanley Works, Newark-on-Trent. 7594 A

FOREMAN MASON.—REQUIRED, a First-class TRADESMAN to Take Charge of Large Erection Job in Granite; man used to Dock or Bridgework preferred.—Address, full particulars, experience, 7613, The Engineer Office. 7613 A

SITUATIONS WANTED.

AN ENGINEER, with Some Spare Time, SEEKS a PART-TIME OPENING or OPENINGS within a radius of 60 miles of London, to control the erection or efficient operation of electrical, Diesel or steam plant, or to assist in management of small works.
Eight years' electrical and mechanical industrial experience in England and three years' experience abroad.
Address, P1540, The Engineer Office. P1540 B

BUYER Shortly OPEN for RE-ENGAGEMENT (45). Over 20 years' experience with leading merchant shippers; keen business man with good personality and address.—Address, P1546, The Engineer Office. P1546 B

CIVIL ENGINEER, B.Sc., and Sections A, B and C of the Institution of Civil Engineers, age 24, SEEKS POST offering designs of large and complex structures with a reasonable salary.—Address, P1543, The Engineer Office. P1543 B

ENGINEERS' CLERK DISENGAGED. Accounts, costs, wages, &c. Thoroughly competent. Could take charge of office. Moderate salary.—Address, P1553, The Engineer Office. P1553 B

ENGINEER (36), Extensive Experience of Modern production methods for the production of instruments, electrical and mechanical, SEEKS POST as Works Manager, Superintendent or Production Manager. Moderate salary.—Address, P1536, The Engineer Office. P1536 B

ENGINEER WORKS and COSTS ACCOUNTANT SEEKS APPOINTMENT; thoroughly experienced and can take full charge; accurate and expeditious costs, stores control, wages, labour, trade union procedure, &c.; practical knowledge of general, agricultural, electrical, road-making machinery, and oil engine branches; economical methods; moderate salary.—Address, P1559, The Engineer Office. P1559 B

INDIAN MECHANICAL and ELECTRICAL ENGINEER, well connected with railway and Government officials, shortly returning to India, own expense, will UNDERTAKE COMMISSIONS or ASSIST British Firm's LOCAL AGENTS. Highest credentials.—Address, P1551, The Engineer Office. P1551 B

MECHANICAL and ELECTRICAL ENGINEER, B.Sc. (36), experienced designer machinery and factory lay-out, erection, maintenance, also boiler and power plant, SEEKS MANAGERIAL or FACTORY ENGINEER'S POST.—Address, P1554, The Engineer Office. P1554 B

SITUATIONS WANTED (continued), Page 2.
PUBLIC NOTICE, Page 2.
AUCTIONS, Page 64.
PARTNERSHIPS, Page 2.
PATENTS, Page 2.
MISCELLANEOUS, Page 2.
AGENCIES, Page 2.
MACHINERY, &c., WANTED, Page 64.
FOR HIRE, Page 64.
BUSINESSES and PREMISES (For Sale, etc.), Page 64.
EDUCATIONAL, Page 2.
FOR SALE, Pages 2 and 4.
WORK WANTED, Page 64.

For Advertisement Rates see Leader Page.

PUBLIC NOTICE

Government of Bombay.

NOTICE.

To IRRIGATION DEPARTMENTS, PORT AUTHORITIES, RAILWAYS, MUNICIPALITIES, ELECTRIC SUPPLY COMPANIES, PUBLIC WORKS CONTRACTORS AND OTHER ADMINISTRATIONS CARRYING OUT LARGE ENGINEERING WORKS.

Notice is hereby given that, owing to the approaching completion of the Lloyd Barrage at Sukkur, large quantities of Plant and Machinery as briefly detailed in the list below will shortly become available for sale. Most of the plant is now available.

All Administrations who have works in progress or who are contemplating works in the near future are invited to consider the subjoined list and to apply to the undersigned for full particulars and prices of any plant which might be of use to them. Enquiries are NOT invited from machinery dealers at the present stage. Most of the plant was purchased new for these works and is in excellent condition. Every item of plant sold will be first overhauled and put in thorough working order before sale and will be open for inspection (and test, wherever possible) by appointment at Sukkur.

Service will also be given after sale and purchasers' men will be trained by arrangements, as long as the Barrage Construction Works and Shops are in existence.

A. A. MUSTO,
C.I.E., M.I.C.E., I.S.E.,
Superintending Engineer, Lloyd Barrage Circle.

Postal Address: Sukkur, Sind, India. Cables: "SUKBAR, SUKKUR."

LIST OF PLANT & MACHINERY.

RAILWAYS.

About 40 miles of 5ft. 6in. gauge Railway complete and 9 Steam Locomotives and about 700 Wagons of all types, including 20-Ton Either-side Tipping Wagons. About 25 miles 2ft. gauge Railway complete and 15 Kerosine and 2 Steam Locos. and about 1100 Either-side Steel Tip Wagons of 27 cubic feet capacity.

FLEET.

Two Shallow-draught Suction Dredgers, by Lobnitz, 20in. discharge, to dredge to 30ft. each, complete with 1000ft. Floating Pipe Line and Terminal Pontoon with 150ft. overhang at 40ft. above water line.

Also Shallow-draught Paddle and Twin-screw Tugs, Motor Launches, Steel Barges, Pontoons, &c.

NOTE.—All motors on electrically driven plant are for A.C., 400 volts, 3-phase, 50 periods.

CRANES.

25-Ton and 10-Ton Electric Floating Derrick Cranes, 10-Ton and 1½-Ton Electric Derrick Cranes, 20-Ton and 2-Ton Steam Derrick Cranes. Also 5-Ton Steam Loco. Cranes and 10-Ton Electric Loco. Cranes, 5ft. 6in. gauge. Also 15-Ton, 12-Ton and 5-Ton Electric Goliath Cranes, 15-Ton Electric Shop Gantry Crane, and 15-Ton Hand-operated All-round Derrick Cranes.

PUMPS.

Sets of 8in., 4in., 3in., and 2in. Direct-coupled Electric Centrifugal Pumps for 40ft. head.

PILE DRIVERS.

Floating and Land Sets with McKiernan-Terry Double-acting Piling Hammers, Spencer-Hopwood Boilers, Zenith Winches and Steel Frames and Leads for driving 45ft. Piling.

STONE CRUSHERS.

"Acme" Jaw Crushers, 24in. by 15in., with Elevators, Hoppers and Screens and Portable Crusher, 12in. by 6in.

CONCRETE MIXERS.

Complete Plants for Moulding 10-Ton Blocks with Travelling Mixer Bridge carrying 2-Yard Ransome Mixers complete with Bunkers, Elevators and Batch Measuring Hoppers for materials, all electric driven. Also Steel Moulds for 10-Ton and 1½-Ton Blocks. Also Electric-driven Portable Mixers of sizes.

AIR COMPRESSORS.

Direct-coupled Electric-driven Sentinel Two-stage Compressors of 300 cubic feet capacity, Belt Drive Ditto of 550, 300, 188, and 140 cubic feet capacity respectively. Pneumatic Tools of all kinds.

DIVING GEAR AND DRESSES, &c.

ELECTRIC POWER PLANT.

Following Diesel Engines direct coupled to Alternators generating A.C., 6600 volts, 3-phase, 50 periods:—

2 Swiss Loco. 4-Cylinder Single-acting Diesels, 750 B.H.P., with Fly-wheel Alternator, 500 kW., by Oerlikon.

Metro-Vickers Cubicle Type Switchboard.

Johnson and Phillips Transformers, 6600 to 400 volts, of sizes.

H.T. and L.T. Overhead Transmission Poles, Cables, &c.

MORTAR MILLS.

Both Over-driven and Under-driven Type Mortar Mills, 8ft. dia. pans, with belt drive from countershaft.

WORKSHOP MACHINERY.

Lathes, Shapers, Planers, Milling Machines, Drilling Machines, Belt Air Hammers, Belt Hammers, Punching and Shearing Machines, Forges, Woodworking Machinery, Plate Rolls, Iron and Brass-foundry Equipment, Saw Sharpening Machines, &c.

QUARRY PLANT.

Compressed Air Drills of all sizes, Forging Machines, Oil Furnaces, Air Compressors, Oil Engines, Wire Saws, Channellers, &c.

STONE DRESSING PLANT.

Diamond Saws, Planers, Frame Saws, Rip Saws, Countershafts, &c.

ENGINES.

Oil Engines of various sizes.

BUILDINGS.

Steel-framed Stone Dressing Shop, 360ft. by 115ft., with 15-Ton Gantry Runway and numerous Smaller Steel Roof Trusses, &c.

STEEL SHEET PILING.

About 11,000 Tons "Universal" 15in. by 5in. by 43 lb. per square foot Interlocking S.S. Piling in 40ft., 45ft., and 50ft. lengths.

MISCELLANEOUS PLANT.

Such as Steel Riveted and Sectional Tanks of all sizes, with and without Staging, Winches, Jacks, Pulleys, Wire Ropes, Motor Lorries, and many other items.

A. A. MUSTO,
S.E.I.,B.C.

MS.13/10.] P.B. 40/30. 6445

SITUATIONS WANTED (continued)

MECHANICAL ENGINEER (28), Public School, A.M.I. Mech. E., A.M.I.N.A., 1st Class B.O.T. and Diploma, DESIRES POSITION; erection, maintenance, or administrative.—Address, P1557, The Engineer Office. P1557 B

DRAUGHTSMAN, Mech., Elec., 20 Years' Experience, reliable, adaptable, SEEKS any suitable POST. Disengaged.—YOUNG, Monmouth-road, Abergavenny. P1538 B

DRAUGHTSMAN (31), Sec. Sch., L'don Gen. Sch. Cert., 4 yrs. exp. lifting and shifting and general patents, 3 yrs. tech. coll., 2 E.M.E.U. Certs., Nat. Cert., studying A.M.I.M.E. Diseng.; cons. anything.—HAYWARD, 77, Marquess-road, N. 1. P1542 B

JUNIOR DRAUGHTSMAN (22), Mechanical, DESIRES POST. Good tech. education, 2 yrs. machine shops, 5 yrs. D.O., laundry, printing and gen. engineering. Wage about £2 15s. start.—Address, P1547, The Engineer Office. P1547 B

STRUCTURAL DRAUGHTSMAN (28, Single), with 11½ years' experience Scotland, England, India, DESIRES SITUATION, go anywhere; design, detailing, estimg. exp., D.O. and works; excellent references, well educated, cultured, ambitious; 5 yrs home.—Address, P1561, The Engineer Office. P1561 B

STRUCTURAL DRAUGHTSMAN, Young, SEEKS IMMEDIATE POSITION; 3 yrs. tech., 3 yrs. D.O. experience, knowledge of hoists, runways, gantries, &c.; suit either structural engineers or contractors. Excellent references.—W. J. PARKER, 71, Cross-road, Southwick, Sussex. P1513 B

PARTNERSHIPS.

ADVERTISER Has the Sole Manufacturing and Selling Rights for British Empire and U.S.A. for new Bearing Metal, containing graphite in colloidal form, and is anxious to GET in TOUCH with PARTY with a view to FORM LIMITED COMPANY for the purpose of exploiting this proposition. Users of bearing metal will gladly be supplied with samples for testing purposes.

For particulars write to E. SIEGRIST, 22, Henrietta-street, London, W.C. 2. P1550 C

CONSTRUCTIONAL ENGINEERS, London, Est. 10 years, consider PARTNER experienced in structural or general building work. Good opportunity for worker with some capital.—Address, P1556, The Engineer Office. P1556 C

ENGINEER (30), A.M.I.A.E., G.I. Mech. E., DESIRES ACTIVE PARTNERSHIP or DIRECTORSHIP in small established mechanical engineering concern in North Midlands; invest £1500.—Address, P1549, The Engineer Office. P1549 C

IN North Midlands a PARTNERSHIP POST WANTED in small Electrical and General Engineering Workshop. Invest £200.—Apply, T. ROPER, and CO., Bromsgrove. P1552 C

EDUCATIONAL.

Correspondence Courses

OF PREPARATION FOR THE

Examinations

OF THE
INST. OF CIVIL ENGINEERS.
INST. OF MECHANICAL ENGRS.
INST. OF STRUCTURAL ENGRS.
UNIVERSITY OF LONDON, &c.
ARE PERSONALLY CONDUCTED BY

Mr. Trevor W. Phillips,

B.Sc., Honours, Engineering, London University, Assoc. M. Inst. C.E., A.M.I. Struct. E., M.R.S.I., F.R.S.A., Chartered Civil Engineer, &c.
For full particulars and advice apply to:—
38, DALE STREET, LIVERPOOL.
LONDON OFFICE:—65, CHANCERY LANE, W.C. 2.

T.I.C.B.

CORRESPONDENCE COURSES

FOR THE

PROFESSIONAL EXAMINATIONS

A.M. Inst. C.E., A.M.I. Mech. E., A.M.I.E.E., A.F.R.Ae.S., etc.

Convincing proof that The T.I.G.B. training is markedly successful is found in the many pages of "The Engineer's Guide to Success" which are filled with typical results of T.I.G.B. Students. This testimony of former Students obviously provides the soundest reason why you too may enrol with The T.I.G.B. with every confidence in the issue.

Write to-day for "The Engineer's Guide to Success" — 140 pages — containing the widest selection of engineering courses in the world, and mention the branch, post or qualification that interests you. The T.I.G.B. guarantees training until successful for the one fee.

THE TECHNOLOGICAL INSTITUTE OF GREAT BRITAIN,
76, Temple Bar House, London, E.C. 4.
(Founded 1917.)

AGENCIES.

AGENTS REQUIRED in the Chief Counties, with first-class connections amongst Steam Users.—Apply, OWENS BOILER CIRCULATOR (1930), Ltd., 57, Victoria-street, S.W. 1. 7237 D

SHANGHAI AND NORTH CHINA.
AN Old-established FIRM of Engineers and Manufacturers Representatives will be OPEN to ACCEPT AGENCIES for:
INTERNAL COMBUSTION ENGINES (all types),
PUMPS (all types),
CONDENSING PLANTS (all types),
STEAM ENGINES and BOILERS (all types),
as from JANUARY 1st, 1932.
Representative now in this country, but is leaving for the Far East on October 15th.
Replies in the first place to be addressed to 7555, The Engineer Office. 7555 D

EXPERIENCED ENGINEER, M.I. Mech. E., M.I. Min. E., own office, DESIRES GOOD AGENCY for London.—Address, P1529, The Engineer Office. P1529 D

RESPONSIBLE AGENTS; Must Have Good connection with engineering firms, for Sale of Grey Iron Castings for up-to-date foundry in Midlands. State districts could cover.—Address, P1548, The Engineer Office. P1548 D

MISCELLANEOUS.

BOOKKEEPING.—Your Accounts Kept Monthly and brought up to date for Audit and for Income Tax Returns. Moderate fee. Write making appointment.—Address, 7601, The Engineer Office. 7601 I

CAPITAL Available (Clients Waiting) for Sound MANUFACTURING and TRADING propositions. Shares and Debentures placed. Ltd. Co. formation, &c.—H. & F. DEVELOPMENTS, Ltd., 6, Guildhall Chas., Basinghall-street, E.C. P1560 I

FOR DISPOSAL to Any Institution or Public Body; (1) Bound Volumes of "THE ENGINEER," 1897 to 1924, and unbound Volumes, 1925 to date. (2) "TRANSACTIONS of the AMERICAN SOCIETY of CIVIL ENGINEERS," 1898 to 1930, bound. For particulars address, 7604, The Engineer Office. 7604 I

ENGINEERS.

SERIOUSLY, if you are earning less than £10 per week you cannot afford to carry on without reading "ENGINEERING OPPORTUNITIES." Whether you are an old hand or a budding apprentice, this 200-page volume will point to a worth-while future. Among other things, the book explains the methods of our unique Appointments Department, gives details of all leading Eng. Exams. (A.M.I.Mech.E., A.M.I.E.E., B.Sc., G.P.O., &c.), and outlines modern Home Study Courses in Civil, Mech., Elec., Motor, Aero, Radio, "Talkie," and all other branches of Engineering. This book will alter your entire outlook and earning power. It is quite FREE. Send for your copy, now.

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY,
22, Shakespeare House, 29-31, Oxford St., London.
7614 I

PATENTS

KINGS PATENT AGENCY, Ltd. (B. T. KING, Regd. Patent Agent, G.B., U.S., and Can.). "Advice handbook" and consultations on Patents and Trade Marks FREE.—146A, Queen Victoria-street, London, E.C. 4. 45 years' ref. 'Phone: Central 0682. 6755 H

PATENT No. 299,029, "Improvements in Lubricators."—PERSONS DESIRING to PURCHASE or OBTAIN LICENCE under the above Patent should apply to Messrs. PHILLIPS and LEIGH, 55/56, Chancery-lane, London, W.C. 2. 7583 H

THE PROPRIETORS of BRITISH PATENT No. 241,171 are PREPARED to SELL the PATENT or to LICENSE British Manufacturers to WORK thereunder. It relates to a cartridge feed device for automatic fire-arms.—Address, BOULT, WADE and TENNANT, 112, Hatton-garden, London, E.C. 1. 7584 H

PATENTS' OWNER, with Capital and Long Experience, REQUIRES CO-OPERATION of Engineers with factory, preferably London. Mass production required. Enormous market available.—Address, P1537, The Engineer Office. P1537 H

PATENTS: "IMPROVEMENTS IN THE BEARINGS FOR THE CRANK SHAFTS OF INTERNAL COMBUSTION ENGINES."
THE PROPRIETORS of Mr. G. Cattaneo's BRITISH PATENT No. 294,167 are DESIROUS of LICENSING the Patent to British Manufacturers, to ensure its use and development, or of SELLING the PATENT outright.
For full information address inquiries to W. P. THOMPSON and CO., Chartered Patent and Trade Mark Agents, 12, Church-street, Liverpool. P1545 H

THE OWNERS of BRITISH PATENTS No. 292,264 and No. 294,432, entitled "Interlocking Joints for Metallic Columns and Girders," are WILLING to ENTER into WORKING ARRANGEMENTS for EXPLOITATION of the same in Great Britain.
Particulars obtainable from TECHNICAL RECORDS, Limited, 59-60, Lincoln's Inn-fields, London, W.C. 2. 7596 H

THE PROPRIETOR of BRITISH PATENT No. 275,070, dated December 17, 1926, pertaining to "Improved Hose and Pipe Coupling," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois. 7602 H

THE PROPRIETORS of BRITISH PATENT No. 281,384, relating to "Increased Torsion Strength of Threading Taps," are PREPARED to SELL the PATENT or ENTER into ARRANGEMENTS by way of LICENCE or otherwise to PRODUCE on reasonable terms. American rights fully covered and will be negotiated separately or jointly.
KNIGHT and BATTEN, Burnham, Bucks. 7605 H

THE PROPRIETORS of BRITISH PATENT No. 259,945, for "Improvements in Protecting Device for Electric Detonators," DESIRE to SELL the PATENT, to GRANT MANUFACTURING LICENCES, or to make other arrangements on reasonable terms for working the invention in this country.—For full particulars, apply to W. BRYSON, Chartered Patent Agent, 29, Southampton-buildings, London, W.C. 2. 7612 H

FOR SALE.

"600"

FOR DISPOSAL.

500 K.W. STEAM DRIVEN MATHER & PLATT Alternator Set. Inverted Type.

Triple Expansion Engine. Steam pressure 130/140 lbs. per sq. inch. Direct coupled to 3150-volt, 3-phase, 50-cycle Alternator.

In Excellent Condition.

Send for full details and price to:

GEORGE COHEN, SONS & Co.
LIMITED,
GAS WORKS ROAD, NEATH.
'Phone: Neath 475. Telegrams: Residuals.

FOR SALE, THEODOLITES.
DRAWING INSTRUMENTS, SECOND-HAND.
CLARKSON'S, 338, High Holborn, W.C.
(Opposite Gray's Inn-road).

FOR SALE, LEVELS.
DRAWING INSTRUMENTS, SECOND-HAND.
CLARKSON'S, 338, High Holborn, W.C.
(Opposite Gray's Inn-road). Ex.

FOR SALE, 120 Tons of FUEL OIL, ·960 spec. gravity. OFFERS WANTED.—Apply, CADBURY BROTHERS, Ltd., Bournville. 7611 G

LANCASHIRE BOILER FOR SALE at Low Price on rails Lynn to save second removal; 30ft. 0in. long, 8ft. 3in. diameter; Thompson dished end with Hopkinson fittings throughout. Will insure National 160 lb.—A. DODMAN and CO., Ltd., King's Lynn. 7554 G

FOR SALE.

"600"

FOR DISPOSAL

3 Very Fine BABCOCK & WILCOX DOUBLE DRUM WATER TUBE BOILERS. W.I.F. Type. Working pressure 160lbs. per square inch. Evaporative capacity 10/12000 lbs.

Complete with Superheaters, Usual Mountings & Fittings.

IN EXCELLENT CONDITION.

Inspection Invited.

Send for full details and prices to:

GEORGE COHEN, SONS & CO.
LIMITED,
GAS WORKS ROAD, NEATH.
Tel.: Neath 476.

ROLL GRINDING MACHINE, by Masson, Scott and Co., M.S. type, size A, for grinding rolls with high surface, two grinding wheels 12in. dia. by 1 7/8in. face, adjustable by hand wheels, 7ft. bed, self-acting feeds, roll carriages, &c., solid steel former for cambering 9in. dia. by 7ft. long, with countershaft. PRICE £150.

ROLL TURNING LATHE, 19in. Centres, to take 8ft. between centres, slotted bed 4ft. wide, 15ft. long, reduction gear drive, requires 10 H.P. motor, 700 r.p.m. PRICE £70.

JOHN CASHMORE, GREAT BRIDGE, STAFFS.

SELECTION OF MACHINE TOOLS.

36in. "Roberts" VERTICAL BORING and TURNING MILLS (Type No. 9), 36in. 4-jaw independent chuck table, tool holder and countershaft (practically new condition).

PLANING MACHINE, high-speed Cincinnati, to plane 6ft. by 2ft. 6in. by 2ft. 6in., single tool-box, fast and loose and reversing pulleys, by G. A. Gray and Co.

8in. CAPSTAN LATHES, by H. W. Ward and Co., 12½in. h.s., hex. turret, 5ft. bed and countershaft.

5½in. CAPSTAN LATHE, by H. W. Ward and Co., 8in. h.s., hex. turret, 3ft. bed and countershaft.

5in. S.C. TOOLROOM LATHE, by Pratt and Whitney, 5ft. bed.

9in. S.S. and S.C. LATHE, by Pollock and McNab, 12in. h.s., all-geared head, 7ft. bed.

16in. stroke SHAPING MACHINE, by Sir W. G. Armstrong, Whitworth, quick return motion, 6ft. bed, "T"-slotted table, 2ft. by 2ft. by 1ft. 9in., with countershaft.

Pillar Type SHAPING MACHINES, 9in. to 18in.

All classes of Machine Tools in stock.

Send your inquiries to

JOHN CASHMORE, GREAT BRIDGE, STAFFS.

STEAM-DRIVEN AMMONIA COMPRESSORS, capacity 200 tons of ice per day.

VERTICAL SURFACE CONDENSING COMPOUND DROP PISTON VALVE STEAM ENGINE, cylinders 27-50 by 36, 180 w.p., 56 r.p.m., 18ft. fly-wheel, 21in. wide, driving TWO HORIZONTAL COMPRESSORS, 18½in. diameter by 36in. stroke. Engine would be suitable for driving a factory. All in excellent condition; 21 years old.

Address, P1498, The Engineer Office. P1498 G

ENGINEER'S

SURPLUS MATERIALS.

OFFERS INVITED.

BOLTS.	
BOLTS & NUTS.	
BRASS.	ROD, STRIP & TUBE.
BRONZE.	PHOSPHOR, STRIP.
EBONITE.	ROD AND SHEET.
NUTS.	BRASS AND STEEL.
PINS.	STEEL, TAPER & SPLIT.
RIVETS.	BRASS, COPPER, IRON & STEEL.
SCREWS.	BRASS AND STEEL.
STEEL.	CAST, CHESTERMAN SPRING & MILD.
WASHERS.	BRASS AND STEEL. P1555 G

Address enquiries to P1555, The Engineer Office.

THOS. W. WARD LTD.

24in. by 20ft. Lang GAP BED LATHE, all geared with 60in. dia. face-plate.

New Summerskill 10ft. by 3ft. 6in. by 3ft. PLANER, three tool-boxes.

New Wilkinson 16in. stroke SLOTTING MACHINE.

28in. by 102in. PLAIN CRANK SHAFT GRINDING MACHINE.

1922 make SLIPWAY HAULING GEAR (Cowans-Sheldon), to haul a gross load of 2400 tons up an incline of 1 in 17.

155ft. 6in. SHEAR LEGS (Tannett-Walker), 75ft. range, two main haul engines, each having two cylinders, 14in. diameter by 12in. stroke.

FOUR Single-ended MARINE BOILERS, 14ft. dia. by 13ft. long, for 180 lb. working pressure.

LAND TYPE BABCOCK WATER-TUBE BOILER of 1827 square feet of heating surface, re-insurable at a working steam pressure of 300 lb. per square inch.

ASK FOR "ALBION" MACHINERY CATALOGUE.
ALBION WORKS, SHEFFIELD. Ex.

400-kW. Belliss STEAM GENERATING SET, 225 volts D.C., V valves, with surface condensing plant if required.

50 H.P. Petter VERTICAL, SEMI-DIESEL CRUDE OIL ENGINE and 60-kW B.T.H. 220-Volt DYNAMO.

Bargains before removal.
HARRY H. GARDAM and CO., Limited, Staines. 7600 G

For continuation of For Sale Advertisements see page 4.

LOCOMOTIVE . MARINE . STATIONARY
"M.I.S."
SUPERHEATERS
To suit all requirements.
Specialists in Design and Manufacture
The SUPERHEATER COMPANY LIMITED
BUSH HOUSE, ALDWYCH, W.C. 2.

A Seven-Day Journal

A New Air Speed Record.

On Tuesday night, Flight-Lieutenant Stainforth, who recently flew one of the "S 6 B" seaplanes equipped with one of the engines supplied for use in the Schneider Cup race at an average speed of 379·5 m.p.h. over a 3 kilom. course, further raised the air speed record to no less than 408·8 m.p.h. The seaplane he was flying was fitted with a special Rolls-Royce engine, of which the estimated life was very short. It was capable of developing 2600 B.H.P., or 300 B.H.P. more than those used for the Schneider Cup race. Owing to the short life of the engine, it was impossible to make any trial flights with the machine, and its capabilities were unknown when Lieut. Stainforth took it into the air. Last Tuesday morning was misty, and though the seaplane was ready to take off at any time the visibility was not sufficiently good until about 5 o'clock in the evening. Even then, according to Lieut. Stainforth's log book, the range was only from 3 to 6 miles—little enough when it is realised that the machine travelled at a speed of very nearly 7 miles a minute. Stainforth made five trips over the course, his times being measured by a special photographic apparatus. On each occasion he dived, as is permitted by the rules, on to the course, and, it is estimated, came as low down as 200ft. above the sea. The course was along the eastern shore of Southampton Water. The official figures for his first four consecutive runs were as follows:—415·2, 405·1, 409·5 and 405·4 m.p.h., giving an average speed of 408·8 m.p.h. over the 3 kiloms. course.

Wages in the Shipbuilding Industry.

On Friday, September 25th, notices were posted in all the federated shipbuilding and ship-repairing yards throughout the country informing the men that the new wage scheme formulated by the Shipbuilding Employers' Federation will begin to operate as from the first full pay week in October. As recorded in our issue of August 28th, the negotiations between the shipyard unions and the employers broke down over the matter of wage revision at a conference held on July 23rd, and after a further joint meeting on August 20th it was decided by the employers to take action without the agreement of the men. Under the new scheme, while no reductions are to be made in the case of plain time workers, who are at present paid in accordance with the national uniform wages scheme, in cases wherein rates above the national rates are paid, such excess up to a maximum total reduction of 2s. 6d. per week will be removed in two instalments. The notices also cover the withdrawal of the 7s. timework bonus, other timework bonuses, and wartime piecework percentages, which will take place in two instalments in October and January. In the case, however, of riveting squads which are employed on piecework, a new scheme of consolidation and simplification of payment has been introduced, and will take effect from the first full pay week in October. The employers' scheme contains a provision that consideration shall be given to any cases of exceptional hardship which may arise from the operation of the new wages scheme. The Shipbuilding Employers' Federation has brought this provision specially to the notice of its members, and we are given to understand that several cases of admitted hardship have already been dealt with.

The Improvement of Port Swettenham.

In a report issued at the end of last week, the Imperial Shipping Committee, presided over by Sir Halford Mackinder, recommends that improvements relating to the provision of additional deep water berths should be made at Port Swettenham, in the Federated Malay States, at an estimated cost of £1,300,000. According to the plan submitted to the Committee, deep-water wharves would be constructed at a new site on the North Klang Strait, about three miles away from the existing port. Consulting engineers state that the site is accessible and suitable for deep-water wharves. The plan in its entirety provides for the construction of 3000ft. of wharfage, with a depth alongside of 33ft. L.W.O.S.T., the width being 145ft. Railway connections, sheds and offices are included. The scheme is divided into three parts. The first part, which the Committee recommends should be started forthwith, provides for the construction of 1000ft. of wharfage, with temporary sheds and offices and single rail connection with the existing port. The Committee, however, recommends that some modifications should be made. First, it is thought that a double line connection with the existing port should be built at the time the first part of the improvement is carried out, and not at a later date, as provided for in the proposals; that the wharfage should be increased to 1200ft. to provide adequate berths for two ocean-going vessels; that the wharf should be made narrower than 145ft. in the first instance, and that road communication between the existing port and the new wharves should be constructed in connection with the carrying out of the first part of the scheme. The consulting engineers estimated the cost of carrying out the first part of the proposals at £1,300,000, and that of the complete scheme at £4,200,000. It was believed by the Committee that no objection would be made to a small increase of port dues to help to meet the cost of the work if an adequate return in the shape of increased efficiency could be ensured.

The Cost of Oil.

In view of the recent wide fluctuations in world currency, which may seriously affect the prices and distribution of lubricants and oil fuels, a joint statement on co-operation has been issued by the Anglo-American Oil Company, Ltd., the Anglo-Persian Oil Company, Ltd., the Burmah Oil Company, Ltd., the Mexican and Canadian Eagle Oil Companies, and the Shell Group of companies. They consider that the present currency difficulties can best be met and most speedily brought to a successful conclusion by the closest possible industrial co-operation, and have decided to that end to collaborate to the fullest extent in the United Kingdom. They will, accordingly, develop ways and means to secure that this co-operation shall afford the unhampered supply of the requirements at the lowest possible cost. They express the hope that other industries and similar organisations will follow their example. The world, they point out, is faced with the most serious crisis in its history, and co-operation amongst the industrialists is the main factor which must tell in the end in providing the remedy for the world's present troubles, because industry provides the only real necessities of life, and gold need not play such an important *rôle*.

Recent Destroyer Launches.

During the present week four destroyers of the 1929 naval programme have been launched, two at Vickers-Armstrongs' Naval Construction Works at Barrow-in-Furness and two at the Portsmouth Dockyard. All four vessels have a displacement of about 1375 tons each, with a speed of 35 knots. The propelling machinery comprises geared turbines, with a designed output of about 34,000 horse-power, steam being raised in water-tube boilers. The main armament includes four 4·7in. guns and eight torpedo tubes. The Vickers-Armstrong ships are named "Cygnet" and "Crescent." At Portsmouth Dockyard on the following day a triple naming ceremony took place, when the two destroyers "Crusader" and "Comet" and the mining tender "Nightingale" were successfully floated out of the dock in which they have been constructed. The two destroyers belong to the 1929 programme and particulars of them are given above. The "Nightingale" is a small vessel of only about 255 tons, with a designed speed of 10 knots. Following the launch of the three ships at Portsmouth, the keels of the flotilla leader "Duncan" and the new cruiser "Neptune," which is in the 1930 programme and a sister ship to the "Orion," were laid down without any official ceremony.

New Cruisers Laid Down.

On Thursday of last week, September 24th, the new cruiser "Leander" was launched at Devonport Dockyard, the naming ceremony being performed by Mrs. A. V. Alexander, wife of the former First Lord of the Admiralty. The keel plate of the "Leander" was laid on September 8th, 1930, and she will be completed in the North Yard most likely early in 1933. She is the only cruiser proceeded with in the 1929 programme, and she will mark a new advance in cruiser construction. Her design was prepared by Mr. A. W. Johns, Director of Naval Construction, and it is understood that considerable deck space has been saved by the trunking of all the uptakes from the boilers into one funnel. The main armament will consist of 6in. guns, instead of the 8in. guns of her immediate predecessors. The machinery for the "Leander" is being built at Barrow by Vickers-Armstrongs, Ltd. Following the launch, the keel plate of the new cruiser "Orion" was laid down. The "Orion" was included in the 1930 programme, and she is a sister ship to the "Neptune," laid down this week at Portsmouth, and the "Achilles." They are 6in.-gun cruisers of new design, for which official particulars as to dimensions or propelling machinery are as yet not available.

Bradford Sewage Works.

The Bradford Corporation's sewage disposal scheme at Esholt was completed last Monday, September 28th, when Mr. Arthur Greenwood set in action the last filter bed. Although, in dry weather, the volume of sewage to be dealt with by the plant is 18,000,000 gallons per day, in times of storm this figure may be raised as high as 96,000,000 gallons. Of the dry weather flow, about one-half is trade waste of an exceedingly strong nature. About 80 per cent. of the wool, grown in this country and imported from abroad, is washed and cleaned at Bradford. During this process it is possible for it to lose as much as 60 per cent. of its original weight in the form of grease, organic and mineral matter. All this matter passes into the trade waste and must be dealt with at Esholt. With the opening of the last filter bed, all the sewage of Bradford will be cleansed and the effluent which flows into the river Aire will be further purified. Eight hundred acres are available for sewage treatment by gravitation, out of a total area of disposal works of three square miles. The grease contained in the trade waste is recovered and a considerable amount of business is done in producing grease and manure. Since the process of recovery was started in 1902, the sales of these materials have brought in a total of £1,334,000. The scheme that has just been completed was started twenty-five years ago and has cost £2,000,000.

James Clerk Maxwell Centenary.

On Thursday last the University of Cambridge began to celebrate the centenary of the birth of its first Cavendish Professor of Experimental Physics, James Clerk Maxwell, who, after Faraday's discoveries, framed the basis for all later development of electrical theory. Delegates to the celebrations, which are being continued to-day, have been nominated by the principal academies and learned societies of the world, and there is a very memorable gathering to pay tribute to Maxwell's genius. The official proceedings began with a luncheon given by the Vice-Chancellor, after which the Chancellor received the delegates in the Senate House. The Master of Trinity then delivered a memorial lecture, which was followed by an "At Home" in Peterhouse—Maxwell's first college. In the evening a reception was given in St. John's College. To-day—Friday—addresses are being delivered in the Arts School by Professor Sir Joseph Larmor, Professor Max Planck, and Professor Niels Bohr, and in Maxwell's laboratory by Sir James Jeans. Short addresses are also being given by contemporaries of Maxwell. The proceedings will close with a dinner in Trinity College. Until the present centenary year, there have been no memorials to Faraday and Maxwell in Westminster Abbey, but recently the Royal Institution and the University of Cambridge obtained the permission of the Dean and Chapter for the placing of memorial tablets to Faraday and Maxwell by the side of Newton's tomb, and they have been unveiled by the Master of Trinity, Sir J. J. Thomson.

The Shipping, Engineering and Machinery Exhibition at Olympia.

The Olympia Exhibition, which closed on Saturday last, was, considering the times in which it was held, very successful. Manufacturers were not deterred by the present industrial depression from taking space at the show to demonstrate what they could produce. It was again noticeable that the makers of, and agents for, foreign machine tools occupied a large section of the Hall, whilst British machine tools were absent owing to the regulations of the Machine Tool Trades Association. Mr. F: W. Bridges, the organiser and manager of the Exhibition, states that unqualified admiration for the high character of the exhibits was expressed by members of all the important institutions, fifty-five in number, which visited the Exhibition. Many inquiries were received, and a large number of orders placed, and increased recognition of the value of the Exhibition came from many quarters, including the Government. In all the circumstances, he regarded the Exhibition as even more successful than any of its predecessors during the last twenty-five years. Those of our readers who were not able to see for themselves the character of the exhibits will be able from the descriptions of the various stands which we have given and continue to give to judge of the high standard maintained.

The Trials of the P. and O. Liner Corfu.

On Friday and Saturday, September 25th and 26th, trials were run on the measured mile at Skelmorlie of the new twin-screw liner "Corfu," which has been built by Alexander Stephen and Son, Ltd., of Linthouse, Glasgow, for the P. and O. Company's London-Bombay, Ceylon and China mail services. Like her sister ship, the "Carthage," which is now approaching completion in the Linthouse Yard, she has a length of 545ft. and a beam of 71ft., with a depth of 46ft. and a measurement of 14,000 gross tons. Her propelling machinery comprises a twin-screw arrangement of Parsons single-reduction geared turbines, constructed by the builders, supplied with steam at 400 lb. pressure and 725 deg. Fah. total temperature by four Yarrow five-drum type water-tube boilers, equipped with the Clyde oil-burning system. On the measured mile speeds up to 19·6 knots were attained at a displacement of 13,000 tons, and the results indicated a particularly good hull form with a reserve of power, while the machinery spaces were remarkably cool, owing to the well-arranged lay-out of the machinery and the modern engine-room ventilating equipment. Under service conditions, with a loaded displacement of about 18,000 tons, it is expected that a service speed of 17·75 knots will be attained, with a good margin of power, on a consumption of about 99 tons of oil per day, while speeds up to 20 knots will be available on the overload rating.

Press-Tool and Fixture Design.

By HENRY C. LANE.

No. VII.—MISCELLANEOUS TOOLS.*

Section I.—Hot Forging Tools.

In Fig. 4, illustrating "Bending Tools," Section I, was shown a piece that, while apparently simple in itself, actually has a tremendous amount of interesting experimental and practical work in its history. The part in question is shown at A in Fig. 52, after the forging work has been carried out. Cut from the ⅝in. by ⅜in. hot rolled mild steel bar, it has one end tapered to half thickness at J, a rectangular hole forged at B to bulge the stock and maintain its strength, flattened to half thickness at C, a name stamped at D, and the end flattened to half thickness at E.

The original method of production of these parts had held good for eighty years, and consisted of hand forging to a slight taper averaging half the stock thickness from the end E to just past the hole B. On the same principle, the end J was shaped, and all necessary holes pierced in a hand press. The smiths' skill and practice produced remarkable regularity, but to keep the essential measurements to the required limits demanded skill, and production was obviously slow. The main points that we had to watch in unskilled production were obtaining the correct thicknesses at C and E, and the essentially accurate measurement between B and J, while the overall length when finished must not vary more than $\frac{1}{16}$in. If the bar were tapered as by hand from B to E, this overall length limit became a big trouble, so it was decided to flatten locally as shown.

The first tools produced for the job were designed

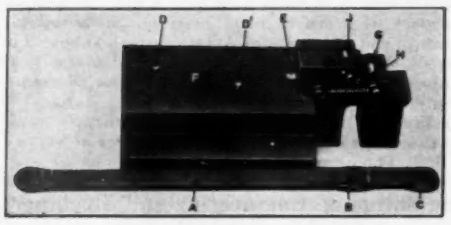


Fig. 48

to carry out the work in a power press giving 25 tons pressure, and apart from gauging details were the same as the tools illustrated in Figs. 48 and 49, which produce the somewhat different and lighter forging shown at A in Fig. 48. These blanks are cut from the ⅜in. by 1in. S.W.G. bar, and flattened to $\frac{1}{16}$in. at B and C. The Fig. 52 blanks had the additional bulge at the hole B, and with a suitable peg fixed to a punch similar to that shown in Fig. 49, and using a plain flat die the press was swung by hand on to a heated bar. Seeing the fly-wheel rapidly reverse at the blow, I equally rapidly decided that the pressure required was far in excess of that given, and accordingly I had a die prepared to flatten C and E at two blows each and a finishing stage to square up the stock and bulge the hole at B. As far as each stage went, the results were quite satisfactory, but the

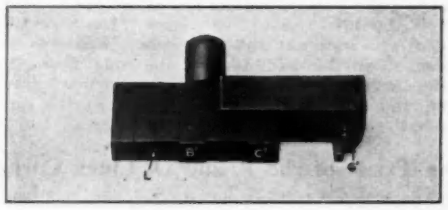


Fig. 49

question of accurate gauging was not so simple of answering. The whole trouble lay with the stop or end gauge for the end E, and to summarise the difficulties, I can do no better than report the various methods tried and the reason for discarding each method. The first stop used was a plain round peg in the die extending upwards $\frac{1}{16}$in. above the die surface. In operation the spreading metal from the hot bar overflowed this peg and spoilt the job. To overcome this, the peg was extended to ⅛in., and mounted on a strong spring, which the punch could overcome in action. The hot metal flowed on each side of the peg and produced an indentation in the edge of the finished bulge. The face of the spring peg was cut so as to recede as rapidly as the flowing metal approached, and the metal rather obviously ran into the gap created between die and spring peg. The next principle adopted worked quite well when brand new, but rapid wear took place. The flattening punch in effect became a piston in a three-quarter cylinder on the die, the wall of the cylinder opposite to the gap in the cylinder being the bar stop. All flow of the hot metal was therefore confined to the cylinder area or away from the final stop; but the rapid wear soon resulted in the metal forming a fin extruded upwards between punch and stop.

From these various failures I had gathered the following information:—Punch and die surfaces must be absolutely solid and of a sufficient area to allow the full flow of the metal. The stop must be in position until the bar was gripped by the descending punch, and must thereafter be removed more rapidly than the outward flow of the metal; furthermore, as punch and die surfaces had to be solid, the direction of motion of the stop was confined to the horizontal. The working out of these points can be gathered from Figs. 48 and 49. The hot bar is placed on the die F and skewed between the two side gauge pegs D and D′, and up against the end gauge E, which is one with the slide G. The slide G is pulled under strong spring tension towards the die F until shoulders engage with the slide cover plate, on which is mounted the punch-supporting roller J. So long as the punch G′ is clear of the drive roller H, therefore, the stop E is in correct position for feeding and the spring pressure is sufficient to withstand all pressure required for gauging the bar. As far as the complete punch is

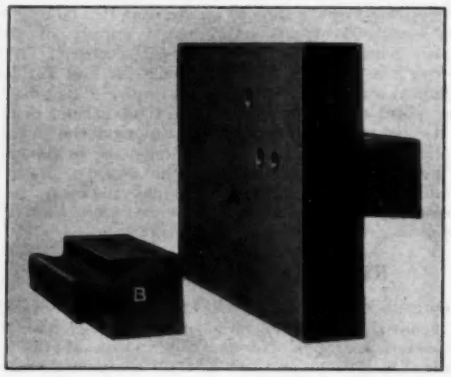


Fig. 50

concerned, K is a block carrying the marking punch L, while B′ and C′ are the actual flattening punches, and G′ the stop slide operating punch. The working face of the punch G′ was arrived at by experiment, and it will be noticed that the first part of the drive face is at an angle to produce a much greater rate of stop withdrawal than would be procured by a simple 45 deg. angle drive. Points B′ and C′ strike the metal simultaneously with the punch G′, striking the roller H and the desired result is obtained.

So much for the first difficulty. Flats B and C in Fig. 48 and similarly flats—Fig. 52—C, E, and J could be produced on a satisfactory basis, but the location of the bulged hole B in the latter illustration was a much more difficult problem, variations in position of up to ⅛in. each way being a regular experience with all usual principles of gauging. Careful consideration showed this variation to be due to three causes—difference in expansion at different heats, difference in flow of metal at different heats, and

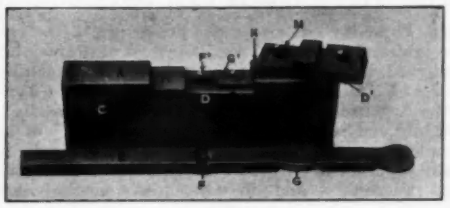


Fig. 51

difference in flow of metal due to different rolled thicknesses. Gauged from J or E these difficulties were insurmountable, and I therefore designed the central peg gauge system described elsewhere—*American Machinist*, Vol. 60, No. 26—and all further trouble was eliminated on this score.

So far, I had been working on a maximum stock thickness of ⅜in., and could continue to produce parts of this thickness satisfactorily on the existing light forging press. Beyond that thickness, however, I could not in safety go, and I was desirous of extending to proportionate work on ½in. thickness. Such production, however, would not warrant the installation of a drop stamp or steam hammer, or even a suitable forging press. Against the advice of various engineers, I installed a ½-cwt. spring hammer, which, if I remember rightly, only cost £30 apart from the special anvil plate shown at A in Fig. 50. The standard hammer block is shown at B in the same illustration, while the standard anvil plate is shown at C in Fig. 51. The anvil block had to be shaped square at the face to give maximum support to the special anvil plate, but otherwise everything was standard. I started with the knowledge that the only reasonable accuracy that I could rely on was that the hammer face would strike parallel to the anvil face, and in approximately the same position each time. The position of striking could, however, vary by ⅛in. upwards, and consequently I could not rely on the punch to convey any detail of shape to the worked bar. Another point was that I should have to incorporate a dead thickness stop for the hammer, if I was not to rely on the skill of the hammer operator. In Fig. 51 one end of a 1in. by ⅜in. bar is shown at E. This end is hole-bulged and slot-flattened at F; ditto at G, and plain flattened at H, after which F and G are pierced with one hole each, and H, after piercing with two holes, is bent to right angles with the main bar. Great accuracy is not required with regard to the end H, therefore it is gauged by eye on the stage H′ of the anvil insert D, which is dove-tailed into the main anvil face block C. If accuracy in H were necessary, it could be centre peg gauged from one of the two holes later in its surface or from the previous bulging at G. F and G are gauged on the centre peg gauge system, and worked on the stages F′ and G′, the bar being turned over for working on stages G′ and H′ after the operation of the stage F′. The opposite end of the bar E, not shown in the illustration, has two holes bulged therein, and is slightly tapered as to thickness a short way past the hole nearest the end. This work is carried out by removing the dove-tailed insert D of the anvil plate C, and substituting that shown at D′, the plain bulged hole being carried out at M, while the bulged hole and tapered thickness is worked on L. Accurate thickness of the finished forgings is definitely preserved by so laying out the anvil block that after allowing for variations in the striking positions of the hammer face, the hammer face always strikes the main block C on the extended portions K. The whole block and the small inserts are, of course, hardened to prevent alteration in shape due to the riveting tendency of the working hammer, and in this manner, as K presents a permenant fixed stop to the hammer face, no variation in thickness of the forgings is possible, providing the ring of hammer on anvil is heard at each process. Tools were also designed, as shown in Fig. 52, to take the forging work of seven blows per piece off the light forging press, and carry the work out in three stages on the spring hammer. For this purpose the special anvil plate A in Fig. 50 was obtained to give a larger surface for the location of the stages, the main die block being clamped by two ⅝in. bolts to this plate. With the exception of the seven small countersink screws and the plate G, all

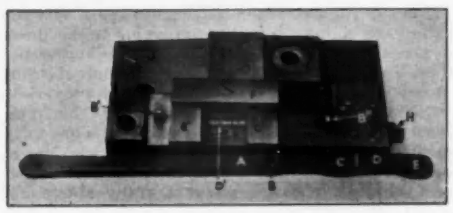


Fig. 52

parts constituting the die block in Fig. 52 are hardened.

As will be seen, in the production of this part on a spring hammer, the central peg gauge system of gauging is only used for the bulged hole B, which is carried out at B′ on the die. C, D, and E are carried out on the next stage, the bar stock being brought at right angles to its original line at the bulging of the hole B. The raised portions C′ and E′ of the die are dovetailed inserts in the main block to allow of easy replacement that is necessitated from time to time by wear or chipping of the edges. The marking punch D′ is a perpendicular insert, and passes clean through the main block, resting for work on the anvil face plate. If it were not for the fact that the pressure exerted on this marking punch is comparatively slight, this method of insertion would not be suitable, some method of distributing the pressure over a greater area being necessary, otherwise the marking punch would tend to bed into the anvil face plate. The hammer is stopped from descending too low by the renewable block F acting for both first and second stages. The peg B′ is shaped from ⅛in. silver steel, and driven into a ⅛in. blind hole half-way through the die block, a small continuing hole, ⅛in. diameter, being provided from the bottom of the ⅛in. hole to allow of easy removal of the peg when renewal becomes necessary. After forging the hole B on the peg B′ the stock is gauged for the second stage process from the hole B, connecting with the gauge peg B″. This gauge peg is the toe of an L-shaped bar sliding in a slot in the die block, and retained in position by the cover plate G. A T-shaped head H is provided at the lower end of this gauge peg bar, which, coming into contact with the die block, will allow motion only up to a certain fixed point towards the flattening point C′ on the die block, but will allow the peg to increase the distance from the flattening point as the metal extends on hammering. Originally, a light spring was fitted to keep the peg in the fully "in" position, but this was deemed unnecessary after a time as the normal operation of the tools required hand pressure on the stock in a direction that would also bring the peg stop to the fully-in position, whether the peg was in that position or not. These first two stages are carried out at the same heat, and on completion of the quantity to be produced the die block is turned so as to bring the third stage J′ under the hammer face. The hammer stop for this stage F′ also acts as an end gauge for the stock,

* No. VI. appeared September 18th.

though, in place of feeding direct to the end stop, better results can be obtained by feeding the stock forward from the beginning of the taper shape on the die up to the final stop while the hammer is running. By so doing the slight possibility of the metal overflowing the final stop, if fed direct thereto, is entirely eliminated, although even if fed direct the tendency is rather against any such overflow, on account of the tapering thickness away from the final stop.

Only one difficulty in the production of these forgings remains to be explained. Fig. 53 shows two variations of the section of the sheared end of the bar stock at A and B, while at C is shown the desired section to produce a satisfactory edge to the forged stock. The forged results of these three sections are shown also in section in Fig. 54 at A, B, and C.

Various designs of cutting-off punches and dies

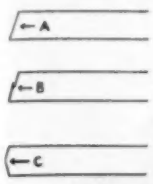


FIG. 53

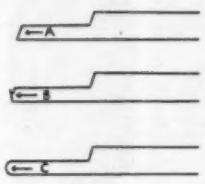


FIG. 54

were tried to endeavour to eliminate the ragged edge shown at B without avail, and for some time the edges were ground or filed to a reasonable shape after the forging operation. Later, it was replaced by grinding the ends of the bars to the right shape before forging, and this produced better finished results, but had the drawback of absorbing a large amount of valuable time. Eventually, the tools shown in Fig. 55 were put into operation, giving the ideal results shown at C in Fig. 53. The tools comprise a double-shaped cropping punch A, fitted with a supporting leg and working in the die A′, whose points B and C are exact replicas of the corresponding shapes on the cutting-off die. Under the sheet metal guard D is a strong strap which serves the

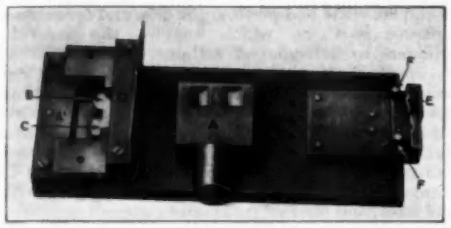


FIG. 55

double purpose of stripping the bar from the punch and preventing the bar rising during the cropping operation more than is required to produce the slight variation from the perpendicular cut, as shown in Fig. 53, C. The bar, after cutting off on the previous tools is placed in position with the previous lower surface uppermost, pulled back to the end gauge E, and across to the appropriate side gauge pin F, and its corresponding side gauge under the stripper at D. After cropping the one end, the bar is reversed and the opposite end cropped in a similar manner on the other side of the die.

Subsequent to the forging operation, the part shown in Fig. 52 has two holes pierced in the flat E, a square hole in the centre of flat C, the remaining web pierced from the blind hole B, and two holes

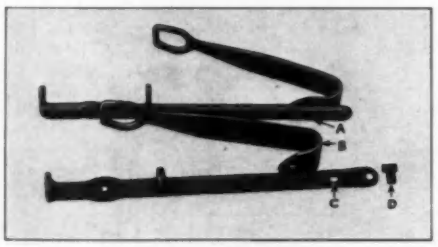


FIG. 56

pierced in the opposite end of the bar, after which the flat E is bent up at right angles, as described in my first article, an upright is riveted in the hole B and a specially shaped spring is riveted to the opposite end, as shown at A in Fig. 56. The three parts to this operation are shown separated in the same photograph, the spring at B, the forged and pierced bar at C, and the rivet at D, which is blanked to a T shape from 6 s.w.g. slit rods. The actual riveting operation is done cold, but just as it actually connects two parts mainly produced by hot processes, so also it forms a good connecting link between the descriptions of the production of the two main parts, even though, of itself, it cannot come under the heading of "hot forging." The job itself was quite capable of production on a hand-press, but it was essential that sufficient pressure was applied not only to head the rivet, but to bulge its shank to make it a dead solid connection. Slack riveting at this point would cause endless trouble in later stages of production, apart from being otherwise unsatisfactory, and it was, therefore, deemed to be inadvisable to rely on the press operator's energy to guarantee results. Sufficient pressure for the job was given by our smallest press, but, on account of height, our largest press would have been necessary for a perpendicular riveting blow. Accordingly, the riveting blow was transferred to the horizontal and to make up for pressure losses an additional leverage was given to the press, as shown in Fig. 57. The angle drive punch A imparts a throw to the riveting punch slide B in the ratio of one to four with the press stroke. The actual riveting punch is shown at C, and is a renewable hardened silver steel insert

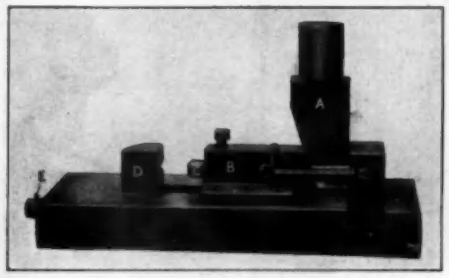


FIG. 57

held by a set screw. The riveting anvil block D is driven right through the die shoe and is locked in position by the set screw E. In operation the rivet is threaded through the two parts and the set slipped into position with the rivet head sliding in the groove in the working face of the anvil. The bend in the spring coming against the anvil acts as a stop if any is needed, but the actual motion of the riveting punch is so short before it strikes the rivet that it is possible to gauge extremely accurately and easily by eye alone. The actual riveted joint is far firmer than obtained by the old methods of hand-hammer riveting, the bulging pressure of the rivet shank actually increasing the size of the holes through which it passes.

(To be continued.)

Railway Organisation in France.

THE problem of adapting new means of transport to existing traffic arrangements is as acute in France as in this country, and calls for an immediate solution if the French railway companies are to carry on their business without fear of a continually increasing deficit. The subject occupied the attention of the Congrès de Génie Civil, which was held during the past week in Paris at the headquarters of the Société des Ingénieurs Civils de France. As the railways have lost their monopoly of transport, they must get down to a more flexible and economical method of working, which means that they must carry on a competitive business by doing in a better way what is at present accomplished by the motor car. But they can only carry on that work when they are allowed to exercise their own initiative and are relieved of crushing burdens in the way of social and other charges that are imposed to the same extent on no other industry. The French railway companies insist that their enterprise should be regarded as a competitive industry, and not as a social institution. It is not admitted that there is necessarily competition between the motor car and the railway. The motor lorry offers facilities in the way of collecting and delivering goods, and is readily available for any distance, and it uses roads, to the upkeep of which it contributes very little. If the railway were equally favoured as regards costs it would be more economical and more convenient for long distances, and the problem that now confronts the railway companies is to organise the railways for express services and long-distance goods traffic, and to utilise motor vehicles for local passenger services and for the collection and delivery of goods.

There is, as yet, no settled opinion upon the way in which the motor car and the railway can be associated to the best advantage, as this will obviously depend upon experience, but the railway companies have laid down the main lines of an organisation which will allow of the different means of transport being utilised in a manner suggested by that experience. There has been too great a tendency to decry the railways because they are confronted with road traffic at a time when they are in financial difficulties, which are attributed mainly to restrictions and charges imposed by the State. They are getting out of their rigid grooves and are spreading on all sides with the use of the internal combustion engine, the rail-bus and the motor car. Very little is heard nowadays about general railway electrification, which, a few years ago, was regarded as an inevitable development of the national electrification scheme. It is probable that it would make the system still more rigid. Even the local railway is not regarded as necessarily a failure, and, at the Congress, Monsieur Montier, a former President of the Société des Ingénieurs Civils, presented a carefully worked out scheme of railways for meeting the requirements of farms, factories and markets, and showed how it could be operated economically and satisfactorily with the removal of certain legislative restrictions. One proposal is that in cities like Paris, where there is great difficulty in dealing with the traffic of central markets, each kind of produce should be packed in separate wagons and carried to stations to be built as near as possible to markets where that particular produce would be distributed. This suggestion is based upon two of the ideas underlying the new system of railway organisation; that is to say: (1) the running of wagons with full loads, and (2) delivering them direct to customers.

Where there is a fairly intensive local traffic, there is something to be said for a better and more economical utilisation of branch lines, but, for more general purposes, Monsieur Barthélémy described a system of tractor and truck which had been built and experimented with by a French firm for taking the wagons off the rail and delivering them to customers. The tractor is of a standard type, and the low-down truck, with normal gauge rails, receives the wagon, there being, naturally, ample security in the way of stability and distribution of load over four pairs of tires. Here, again, the economy of the system lies in dealing with full loads.

The first step in the reorganisation of traffic by associating the motor car with the railway is being undertaken by the Chemins de Fer du Nord, and was described by Monsieur Javary, the traffic manager, who showed projections of the Nord railway system as it is now, and as it will be when the company is able to carry out its plans. The length of the system will then be reduced by about one-half. The main lines will serve the big towns with express trains, and short branch lines and motor car services will connect up all the outlying districts. A beginning will be made at Guise, where three branch lines, having a total length of about 76 miles, will go to Laon, Hirson and Cateau, which thus become "centre stations." One goods train will run both ways each day, and passengers and luggage and parcels will be carried by road. The motor car will, thus, become the main factor in dealing with the lighter traffic and in collecting goods for the rail. Monsieur Javary declared that that system would allow of an economy of more than a million francs a year, with, presumably, a more efficient service and increasing traffic. That is an experiment which can only be carried out when sanctioned by the Government; but there is little doubt that the necessary authority will be obtained, for it is intended to demonstrate the practical character of a plan which has been adopted in principle by all the railway companies. At the same time, the companies must have their liberty and be relieved of State burdens and Parliamentary interferences. Given that improvement in their position, the railway companies are convinced that they can modernise traffic conditions in a way satisfactory to users and profitable to themselves.

The Shipping, Engineering and Machinery Exhibition at Olympia.

No. IV.*

AVELING AND PORTER, LTD.

ON the stand of Davey, Paxman and Co., Ltd., whose exhibits were referred to in our issue of September 18th, an "Aveling Invicta" oil engine manufactured under Acro licence by the associated firm of Aveling and Porter, Ltd., of Rochester, was shown. The engine, which is of the four-cylinder vertical type, is designed to develop 50 B.H.P. at 1200 r.p.m. and has a cylinder bore of 4¼in. with a stroke of 6¾in. It was shown coupled to a 27-kW shunt-wound "Bull" motor, the whole unit being mounted on a common base-plate. Fig. 108, p. 352, illustrates the engine, which has some new features, including centrifugally cast chrome nickel iron liners, which are separate from the crank case and are easily removed for inspection. The crank shaft is of the short close-coupled pattern with 3in. diameter crank pins. The shaft is dynamically balanced and is supported on three heavy roller bearings.

Forced lubrication is fitted throughout, and a special feature of the engine is the arrangement whereby the oil is fed direct into the crank shaft without the intervention of pipes. The cylinder block is cast in one piece with the crank case and is furnished with a large inspection door on the offside, which permits of dismantling the connecting-rods and pistons without having to remove the crank shaft or oil pump, while the cylinder head, which is a separate unit carrying the rocker shaft and valve mechanism, is provided with ample water passages around the valves and fuel injection nozzle seating.

The fuel injectors and fuel pump are of the Bosch pattern, giving a complete independent fuel pump of the constant-stroke single-plunger type per cylinder. The system is designed to give an accurate measure-

* No. III. appeared September 25th.

ment of the quantity of fuel delivered, at all speeds and loads quite independently of the injection pressure.

As an example of the reliability of the engine we are informed that a tractor fitted with one recently ran continuously day and night drawing a four-furrow plough over a period of 977 hours, the run being under official supervision, with all the controls and openings to the engine officially sealed. After the completion of this test the machine was dismantled, and we understand that no trace of wear or deterioration was found on any part.

Loranco Ltd.

The stand of Loranco Ltd., 65a, Fenchurch-street, London, E.C. 3, was full of interesting and ingenious tools. This stand was in the gallery, and it may be as well to point out that the firm has now moved its offices and stores to 42, Newlands Park, S.E. 26.

The tools on this stand were mostly of foreign manufacture and represented the latest efforts of continental and American toolmakers. They included specimens of the files which we described in our issue of December 28th, 1928, which have their teeth milled out of the solid. At the time when we last inspected them the half-round files were made by milling the teeth on a flat strip and then curving it to the half round. With that arrangement the back of the file was, of course, hollow and smooth, and could not be used for cutting. Now these files are made by a kind of turning process, in which the teeth are cut in a lathe on a round bar. The bar is then split endways and teeth cut on the flat. Another interesting exhibit was a twist drill, which had been cut in half. The blanks for these drills are made by a rolling process, in which the flutes are produced by twisting the blank as it is rolled. The etched surface of the section showed plainly how the grain of the metal follows the fluting and, naturally, results in a stronger drill than one milled out of the solid. There were also, on this stand, a number of milling cutters of high-speed steel and unusual form, reamers and so forth. There was an ingenious machine for printing name plates either by sinking or embossing, and several machines with flexible drives for working rotary tools in bench work, such as die sinking.

Gleniffer Engines, Ltd.

The high-speed Gleniffer heavy-oil engine was first shown two years ago at the Olympia Exhibition, and in its smaller sizes it was fully described in our issue of September 13th for that year. This type of prime mover has since found an extended application for marine propulsion and auxiliary work, the types of ship fitted with Gleniffer engines ranging from fishing boats to dredgers, large motor yachts, and cruisers. Amongst exhibits shown on the stand was a 12 kW generating set, comprising a four-cylinder petrol-paraffin engine, and typical of a range of engines from 7 up to 105 B.H.P., available for auxiliary and lighting services.

Larger heavy-oil engines which comprise a series of three, four, six and eight-cylinder units, with outputs from 45–60, 60–80, 90–120 and 120–160 at 700 r.p.m. to 900 r.p.m., were represented by a three-cylinder unit, without reverse gear, a four-cylinder engine complete with reverse and reducing gears, and the six-cylinder unit shown in Fig. 112 on page 352, which was complete with reverse gear and was in actual operation. This unit served to demonstrate the flexibility of the engine, and the ease with which it is started up and manœuvred. It was shown in operation at full speed, and also idling well below 200 r.p.m., at which speed the reverse gear could be operated silently and without affecting in any way the engine speed. Engines in this series have a cylinder bore of 6in. with a stroke of 7in., and are designed for a normal running speed of 700 r.p.m. to 900 r.p.m.

An essential feature of the latest design is the four-radial-cylinder, air-starting motor, which will be seen to the left of our illustration. This air motor can give the engine thirty starts, including the first from cold, from an air receiver of 3½ cubic feet capacity. For re-charging the receiver, which can be accomplished in a few minutes, it is only necessary to cut out one of the fuel pumps and to open a charging valve on that cylinder. The lubricating arrangement includes a double pump of the valveless oscillating type, one unit of which serves as a crank case scavenge pump, while the other is a force pump, delivering oil to the forced lubrication system. A double-acting water-circulating pump of the plunger type is fitted for the cooling water, and, when necessary, a bilge pump of the same pattern can be supplied. The fuel injection system is of the Bosch type, with governor and hand controls. Other features include thermo-syphonic cooling and a water-cooled exhaust. The engine was, we found remarkably smooth in its running and very easy to control. As an example of the small cylinder liner wear which is obtained, a liner removed after 3200 hours of operation at 825 r.p.m. was exhibited. It showed 0·005in. wear at the top, 0·0035in. a little lower, 0·002in. further down, and 0·0015in. near the gudgeon pin, the wear from the middle of the liner to the bottom being only 0·0005in. An exhaust valve taken from the same engine which was overhauled for inspection after running from January 1st till mid-July last, representing 1385 hours of operation, was exhibited, and showed a clean seat free from any scoring.

Petters Ltd.

The largest exhibit on the stand of Petters, Ltd., of Westland Works, Yeovil, was a four-cylinder 160 B.H.P. "Atomic" heavy oil engine, which was shown in operation. The engine and its single-wheel starting and reversing control system were fully described in The Engineer of February 20th last. As exhibited at Olympia it served to demonstrate the very smooth running at speeds down to one-quarter full speed, with reversal in from four to six seconds. The unit is of the four-cylinder pattern, with a bore of 10in. and a stroke of 14½in., the designed running speed being 330 r.p.m. In order to supply starting and manœuvring air a small oil engine-driven unit illustrated in Fig. 89 is used. It comprises a single-cylinder Petter 8 B.H.P. compression-ignition engine having a bore of 6in. with a stroke of 5½in. The set runs at 550 r.p.m. and is directly coupled to a two-stage Reavell compressor. The compact design of the two units, which are mounted on a single bed-plate, may be noted.

A new exhibit was the twin-cylinder 24 B.H.P. 525 r.p.m. "Atomic" marine engine with a bore of 5⅞in. and an 8½in. stroke, which we illustrate in Figs. 88 and 90. The bed-plate, crank case and cylinders are separate castings, which enables the individual cylinders to be removed without having to disturb the crank shaft or the main bearings. The cylinder heads are cast iron and are furnished with removable steel covers which allow any deposit to be removed from the water spaces. The pistons are of the firm's standard design, with four rings at the head and a scraper ring at the bottom of the skirt. The fuel pumps and atomisers are of the Bosch pattern with a fuel filter, and the fuel pump and governor mechanism are totally enclosed and run in an oil bath. The cylinder heads are fitted with compression release valves for starting purposes, and these fittings are so designed that a wick type of starter can be employed in an emergency. Starting is normally effected by compressed air on the distributor system, the air compressor being mounted at the fly-wheel end of the engine along with the bilge and circulating pumps. An automatic unloading device cuts out the compressor when it is not required. The large and small ends of the connecting-rods and the pistons and cylinder walls are lubricated by a mechanical oiler of the firm's patented "Calibrator" type, which is mounted above the speed control lever at the after end of the engine. The crank shaft and the main bearings are designed for forced lubrication and the reverse gear runs in an oil bath. Dip sticks are arranged within the bed-plate so that the exact level of oil in the different sumps may be quickly determined. The reverse gear is of the Petter type and is complete with a thrust block. The whole unit has

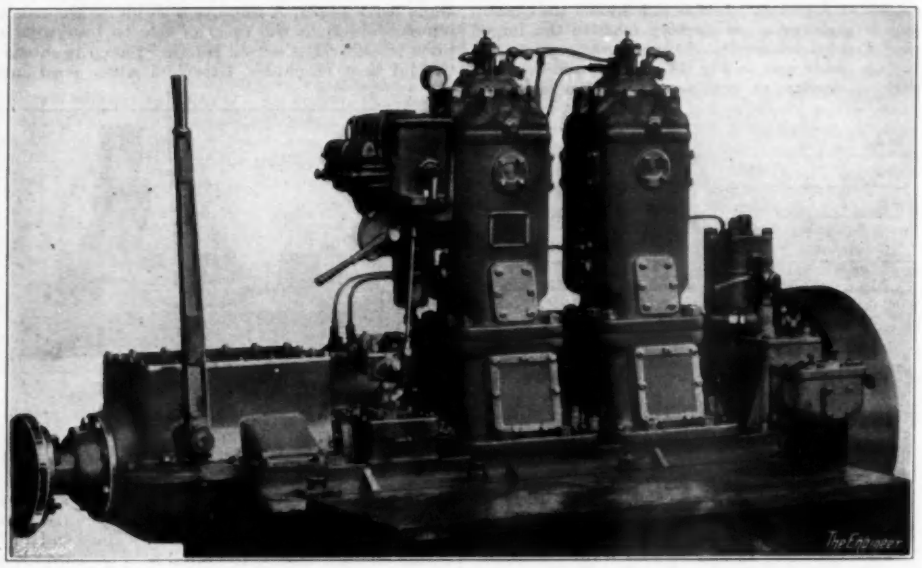


Fig. 88—24 B.H.P. Marine Oil Engine with Reversing Gear—Petters

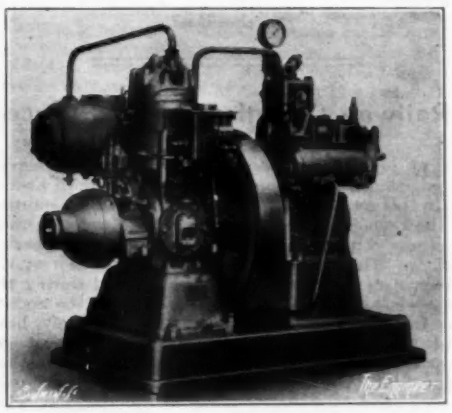


Fig. 89—Air Compressor Set—Petters

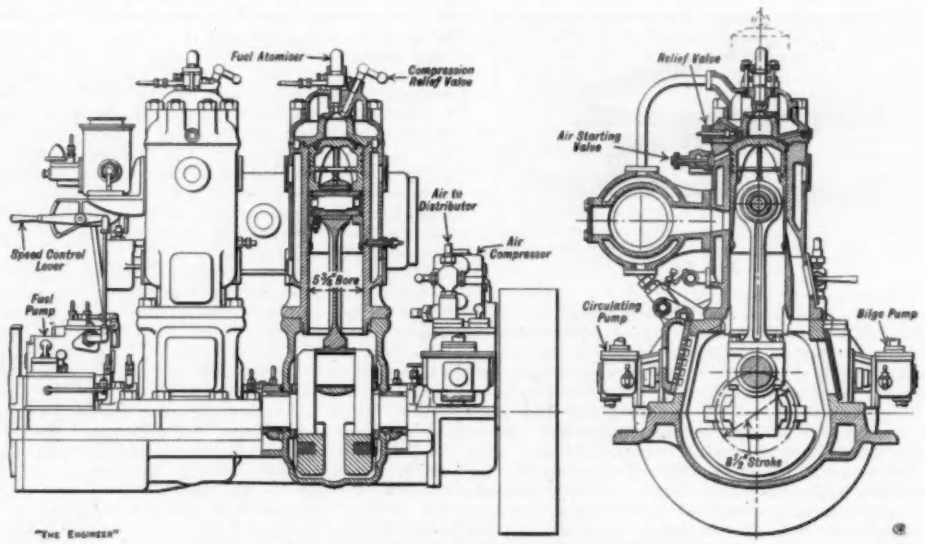


Fig. 90—24 B.H.P. Marine Oil Engine—Petters

been designed so that it can be easily controlled by a single attendant, and is useful for a wide range of marine work.

ARTHUR ROSS, HOTCHKISS AND CO., LTD.

The Hotchkiss circulator was the most important exhibit on the stand of Arthur Ross, Hotchkiss and Co., Ltd., of 1, Glengall-road, London. Small glass models to illustrate the action of the apparatus were to be seen and the flow of the water could be followed. The drawing Fig. 91 is a diagram to show the working of the circulator in a Lancashire boiler. It consists of a pot mounted on top of the boiler with a pipe connected to it on each side and a baffle extending down the middle of the pot between the two. The

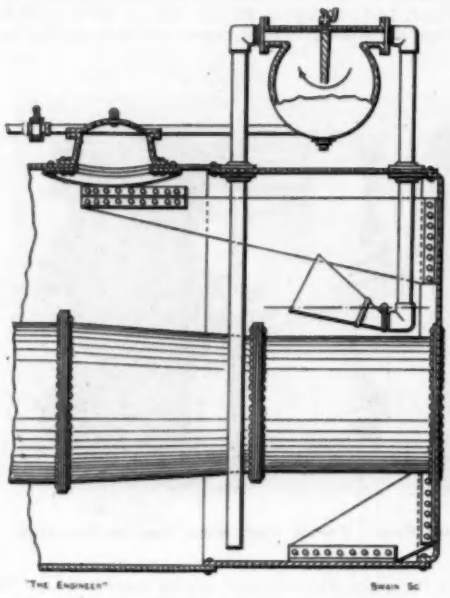


FIG. 91—WATER CIRCULATOR—HOTCHKISS

hotter water from above the flue rises into the funnel and travels up the tube into the pot. Passing under the baffle, the reduced velocity allows the mud to settle out. Continuing its circuit, water returns to the boiler below the flue at the bottom. The Hotchkiss circulator, it is claimed, maintains the water in motion and thus relieves the boiler shell of stresses caused by temperature differences in the various parts. The advantage is also claimed for it that it collects the mud that normally would settle in the boiler itself.

The firm also exhibited special paints for steel and various boiler compositions.

OZONAIR, LTD.

The necessity for clean air, not only for inlet to compressors, oil engines, and other machinery, but also in factories, shops, and halls, is felt more and more

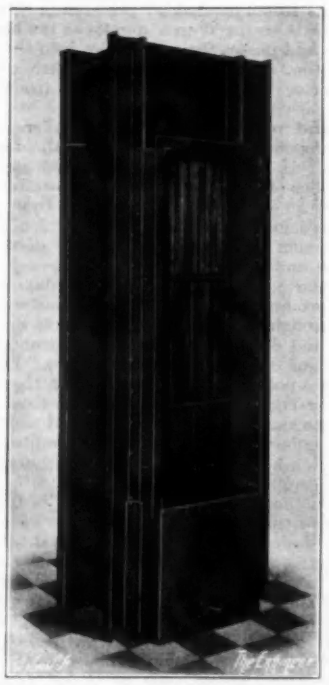


FIG. 92—SELF-CLEANING AIR FILTER—OZONAIR

every day. By filtering the air before it enters a building or factory the cost of cleaning and washing may be much reduced and the health of the workers appreciably improved. Ozonair, Ltd., of St. Leonard-street, Westminster, S.W., brought out some years ago an air filter, called the Ventex, made up in panels, either square or rectangular, by the use of which, bolted together, any desired area for any desired volume of air could be built up. The type of filter employed is clearly shown in the drawing, Fig. 94. The air is drawn or forced through a number of metal plates arranged in a zigzag formation, so that the direction of flow is continually changing. The plates are covered with a viscous oily fluid,

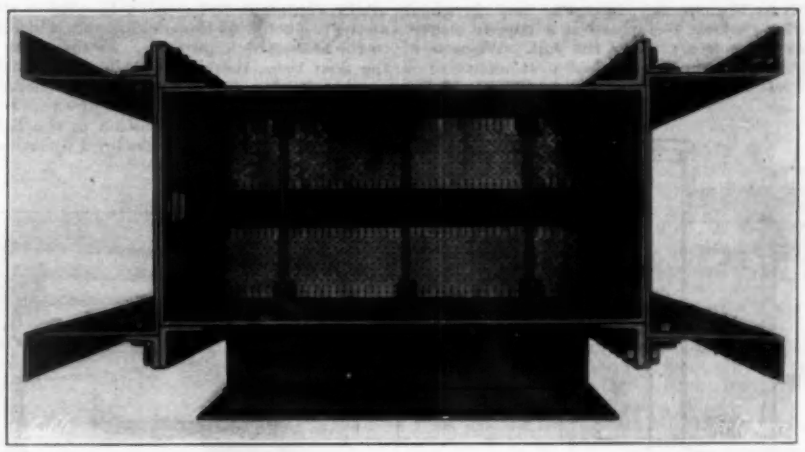


FIG. 93—VIEW INTO TOP TANK OF SELF-CLEANING AIR FILTER—OZONAIR

to which, when the air impinges against it, particles of dust and dirt stick.

The firm's earlier type of filter had the plates arranged horizontally, and each panel required to be removed at intervals for cleaning. A few years ago, however, a self-cleaning type of filter was introduced, and the plates were then arranged vertically. A filter panel similar to that shown at the Exhibition can be seen in the photograph we reproduce in Fig. 92. A tank is arranged at the bottom containing a viscous oil. This oil may be raised to a tank at the top by means of a small hand pump or, in the larger sizes, by means of a motor-driven pump. From the tank at the top the oil can pass through a number of small holes on to the plates, and running down them carries with it the dirt and dust that has collected. When the stream has been shut off again a film of oil is left on the plates ready to catch the dirt again. The filter should be cleaned about once

FIG. 94

a day. Between the bottom tank and the top one, and, of course, on the discharge side of the pump, a filter is incorporated, so that the oil running down the plates from the top is clean. On the stand the oil strainer was of the Auto-Klean type, similar to those described in the Supplement to THE ENGINEER of September 11th last. The photograph reproduced in Fig. 93 is a view from above into the tank at the top of the air filter, and shows the method of holding the plates in position and the holes through which the oil can percolate on to them.

Many advantages are claimed for the Ventex filter. It is efficient and cannot choke; it is easily cleaned; and it is silent in operation. Tests have been carried out at 50 per cent. above the normal rating

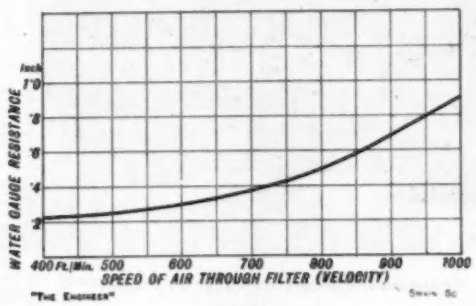


FIG. 95

without any tendency to whistle being noticeable. The resistance to air flow is low. For the ordinary type with horizontal plates and of the standard size of 18in. square, the water gauge pressure required to pass 800 cubic feet of air per minute is given to us by the makers as 0·25in. In Fig. 95 we give a graph supplied to us by Ozonair, Ltd., which shows the relation between the air speed through the self-cleaning type filter and the water gauge resistance.

A filter of the standard type—not self-cleaning—was submitted for an independent test to Professor Barker, of London University, who reported that particles of dust larger than 0·0002in. could not be detected in the air that had passed through the filter, even at comparatively slow rates of flow—in the neighbourhood of 300ft. to 650ft. per minute. Smaller particles such as those visible under a high-powered microscope were removed to the extent of about 50 per cent. at a velocity of 600ft. per minute.

Refinements added to the filter include an electric heater unit fitted in the bottom tank which can be used if, in the event of cold weather, the viscosity of the oil has become such that it may interfere with the cleaning process. That operation, it may be remarked, may take any time from 5 min. to 30 min., according to the amount of dirt on the plates. Since the plates at the front of the filter become dirtiest, it is only necessary to see that they have been cleaned to know that those behind are also clean. In the self-cleaning filter the viscous surface over which the air passes is equivalent to seventy-two times the face area of the filter.

MAURICE WARLOW AND CO.

An indicator for determining at a distance the variations in water levels, the degree of opening of

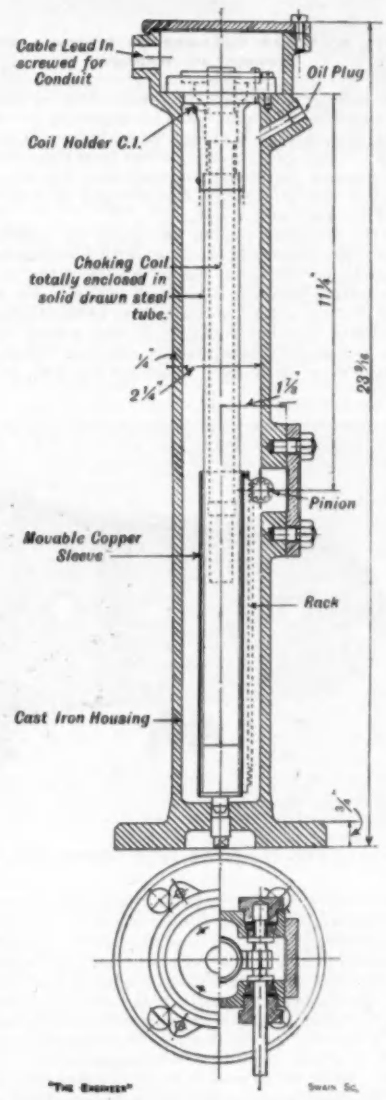


FIG. 96—WATER LEVEL INDICATOR—WARLOW

valves or similar mechanical movements was exhibited by Maurice Warlow and Co., of 12, Victoria-street, S.W. 1. It consists of a transmitter which

is fixed at the point where the variations occur and an indicator which can be placed at any desired position remote from the transmitter, which has no electrical contacts, and as all the electrical parts of the transmitter are enclosed it is unaffected by corrosive effects and other adverse conditions. The illustration Fig. 96 shows a section through a standard transmitter, which consists of an ordinary choking coil completely enclosed in a metal housing and terminals are brought out to a junction box for connection to the circuit. Over the housing which encloses the choking coil there is a copper sleeve, which can move freely along the coil. When it is required to show the mechanical movements of a

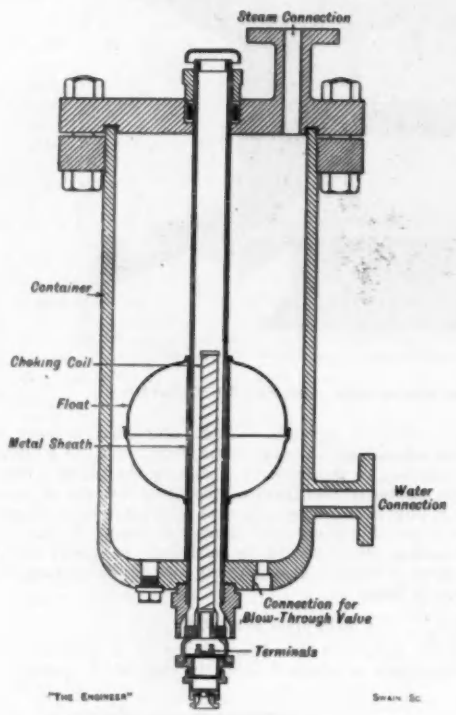


FIG. 97—FLOAT CHAMBER OF WATER LEVEL INDICATOR—WARLOW

sluice gate or gasholder the transmitter is provided with suitable gearing or cams for repeating the movements or positions that are to be transmitted electrically, whilst in the case of water level transmissions arrangements are made for operating the sleeve by means of a float through the medium of a sprocket wheel and rack and pinion.

If the choking coil is energised by alternating current and connected in circuit with a voltmeter, the variations in voltage at the terminals of the choking coil resulting from the movement of the copper sleeve along the coil will be an indication of the position of the sleeve, and consequently of the water level or other movement it is desired to indicate. Apart from the fact that there are no moving contacts, there is only one moving part, namely, the copper sleeve, and as the movement of this sleeve is practically frictionless, extremely accurate readings are obtained, and the instrument requires no attention. In the case of the transmitter illustrated a sprocket wheel operates the copper sleeve by means of an ordinary rack and pinion, but if required it is possible to operate the sleeve directly from a float. For extremely accurate work or where considerable changes in the voltage occur compensated indicators can be supplied, giving true readings even if the voltage variations are as great as 50 per cent.

The apparatus has been applied with marked success to the indication of the water level in boilers, so that indications of the water level may be obtained at any desired point or points away from the boiler, as, for example, in the engineer's office or at the firing floor. As will be gathered from Fig. 97, the actuator is connected to the steam and water spaces of the drum, and the actuator float rises and falls with the water and its movements correspond to the actual water level variations.

All parts of the apparatus subject to boiler pressure are made of drawn or forged material, and a drawn metal tube attached to a flange bolted to the bottom of the container and passing through a stuffing-box at the top contains the choking coil, which is exposed to the atmospheric pressure. As the water level rises the float rises, thereby lessening the shielding effect on the choking coil and the E.M.F. therefore varies continuously as the float moves upwards to its upper maximum limit. The variation in the E.M.F. is in direct proportion to the water level variation and may be indicated in any desired position by running an ordinary two-wire cable from the choking coil terminals to the indicator.

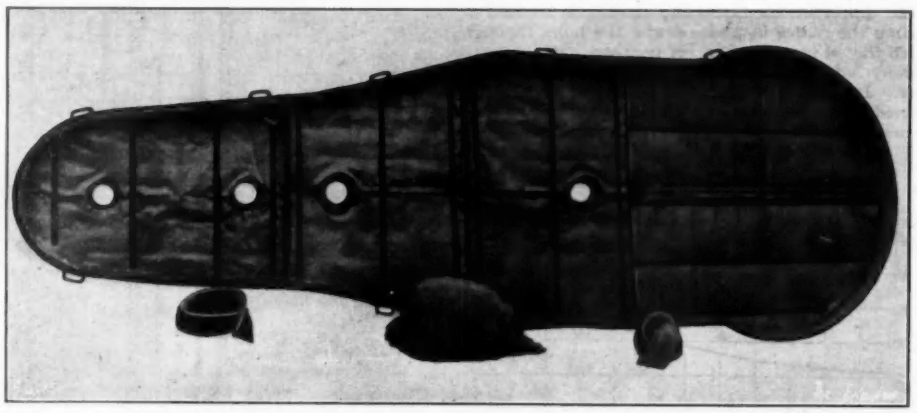


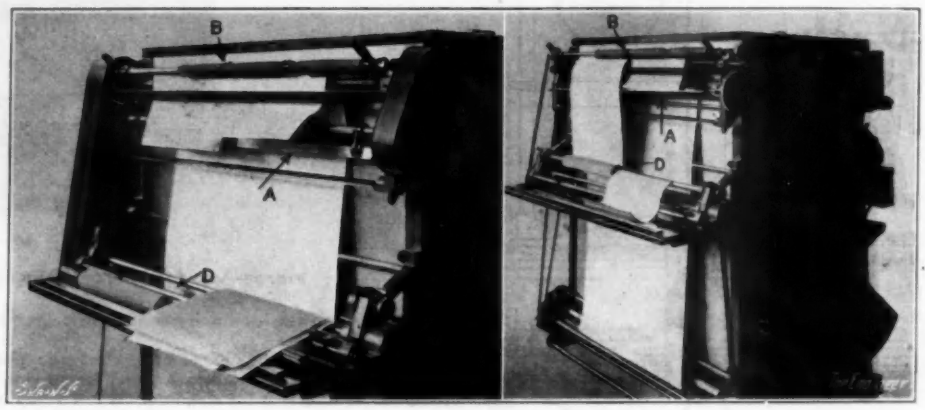
FIG. 98—GLASS SILK COVER FOR TRIPLE EXPANSION ENGINE—CHANCE BROTHERS

Chance Brothers and Co., Ltd.

An interesting display of glass silk in the various forms in which it is utilised as a heat insulating material was to be seen on the stand of Chance Brothers and Co., Ltd., of Firhill Works, Glasgow. The method of producing glass silk was described in The Engineer of August 7th last. The silk fibres are drawn in groups from electrically heated furnaces on to revolving drums, and the material when cut from the drums is received into the making-up department or stock room in long silky skeins. Examples of glass silk in this form were shown on the stand. Material of this type in which the long fibre is retained is frequently supplied for filtration purposes. In the form of ravelled glass silk an insulating material for packing into enclosed spaces is also produced, while other forms include gelatinised and sewn sheets. The principal form, however, in which glass silk is used is in a mattress, which is produced by imposing several thin layers or veils of silk one on top of the other. The mattress so formed is then cut to the required shape or is made up into standard strips, which are sewn in such a manner that the formation of end splices, without fraying the material, is facilitated. Glass silk strip is manufactured in standard widths of 3in., 4in., and 6in. and in two nominal thicknesses of ¼in. and ½in., and is so used for pipe covering. The mattresses consist of silk in ravelled or gelatinised sheets, which may be enclosed in wire netting, wire gauze or asbestos cloth, &c., as desired, and furnished with hooks at the edges for holding the cover in the desired position. An example of such a construction is the cylinder top cover illustrated in Fig. 98, which was designed for a triple-expansion marine engine having cylinder bores of 26in., 44in., and 73in. respectively with a stroke of 48in. The firm also showed a series of pressed glass silk plates which are utilised for placing between the battery plates of accumulators. The application of glass silk for various uses, including highly superheated steam installations, was illustrated by photographs, and we may state in this connection that the high-pressure 1200 lb. Babcock and Wilcox water-tube boiler now approaching completion at Renfrew will be insulated with glass silk.

Precision Photo Printing Plant, Ltd.

There was a wide variety of apparatus for use in the drawing-office on the stand of Precision Photo Printing Plant, Ltd., Salisbury House, E.C. 2, which included some items described in these columns before, such as the print-washing and drying machine—see The Engineer, January 24th, 1930 — photo-copying machines, machines for washing photographic prints free from hypo, and a photographic copying apparatus made by Alfred Herbert, Ltd., of Coventry. There was also the apparatus, illustrated by Figs. 99 and 100, for sensitising blue-print paper, which is made by R. W. Munro, Ltd., of South Tottenham.



FIGS. 99 AND 100—APPARATUS FOR SENSITISING BLUE PRINT PAPER—PRECISION PHOTO PRINTING

This machine has been on the market for some time, but the model shown at the Exhibition has been improved by the addition of apparatus for cutting up the sensitised paper into any standard sizes of sheets. The machine, which is compact and self-contained, occupies a floor space of 5ft. by 5ft., is 5ft. 6in. high, and coats paper up to 40in. wide. It consists of an asbestos-lined drying chamber standing on the four cast iron girders which carry the supply wheel brackets. Access to the inside is obtained easily by removing the top and opening the side door. The drying chamber or oven is gas heated, the burners being shrouded and the temperature is controlled by means of a cock. Electrical heating can be supplied, but gas is recommended by preference. The roll of raw paper is arranged on a spindle at the back of the machine and passes through guides into the chamber at the top. It goes over a number of rolls in the interior and emerges in the front at the bottom.

The head for coating the paper with ferro-prussiate is an independent unit arranged at the rear of the machine. It consists of an enamelled steel trough and a roller of steel covered with vulcanite, which is driven by an enclosed bevel gear drive from the front. The sensitising solution is contained in a jar placed on a wooden shelf fixed to the side of the drying chamber, and is fed to the trough through a rubber tube. Above the coating roller is a glass scraper to take off excess solution. A tension device draws the paper through the machine and controls the speed of coating and drying. The re-reeling arrangements at the front of the machine comprise two "D" section steel tubes polished and plated. These together form a circular core upon which the sensitised paper is reeled into small rolls, and, being fitted with specially formed ends which engage with an adjustable disc and friction holder, they are easily withdrawn as the rolls are completed.

The cutting-up mechanism, which is the subject of our two engravings, slits the paper longitudinally into any desired widths, and then cuts it transversely into lengths. The sensitised paper emerging at the bottom of the chamber is taken up the front of the machine and over a roller at the top. It then passes between a pair of rubber-covered rolls B, which are fitted at any desired intervals with slitting discs. These discs make the longitudinal cuts. The paper is then passed either over or under a guide bar. If it goes over—as shown on the left in Fig. 100—it can be re-rolled in the sensitised form on the roll D. If it goes under the bar it is cut off by the rotary shear blade A—as shown on the right. This blade is rotated by the gear C, which can be changed like that of a screw-cutting lathe, so that the relative rates of the feed of the paper and the rotation of the blade can be varied to suit the length of sheets required.

The cut sheets drop out on to a table in front of the machine.

Blackstone and Co., Ltd.

In addition to two single-cylinder horizontal spring injection oil engines, a number of small power petrol engines and examples of the firm's "Unchokeable" centrifugal pump, Blackstone and Co., Ltd., of Stamford, exhibited a full range of high-speed airless-injection heavy oil engines, which are noteworthy as being of all-British design, incorporating the Blackstone patented spring injection principle as applied

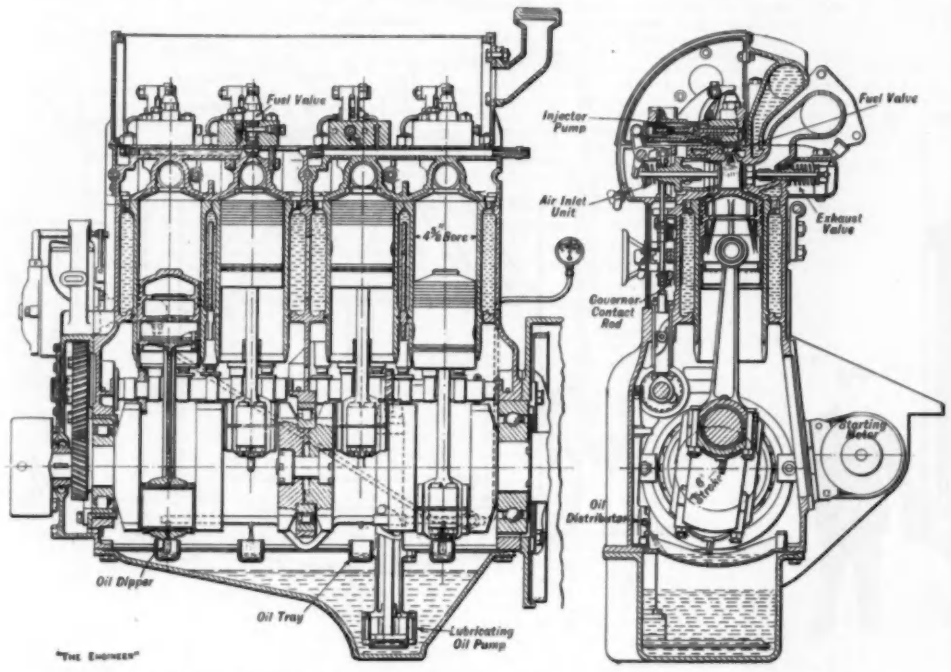


FIG. 101—SECTIONS THROUGH FOUR-CYLINDER HIGH-SPEED ENGINE—BLACKSTONE

to high-speed practice. The sizes of engines shown included the one, two, four and six-cylinder units with designed outputs of 9–10, 18–20, 36–40 and 55–60 B.H.P. at 1000 r.p.m. We reproduce in Fig. 101 a section through the four-cylinder engine, while on page 352, Fig. 109, an outside view of the same unit is given. The design is noteworthy for several novel features. We need not refer in detail to the spring injection principle, which has on more than one occasion been fully described in our columns. Its application to high-speed engines has resulted, we learn, in very efficient combustion being obtained, while the system has the further advantage that the

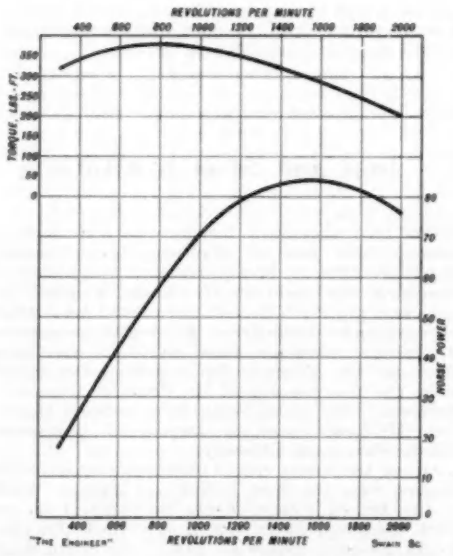

REVOLUTIONS PER MINUTE
400 600 800 1000 1200 1400 1600 1800 2000
TORQUE, LBS.-FT.
350 300 250 200 150 100 50 0
HORSE POWER
80 70 60 50 40 30 20 10 0
"The Engineer"
REVOLUTIONS PER MINUTE
Swain Sc.

FIG. 102—CHARACTERISTIC CURVES—BLACKSTONE

fuel oil is not subjected to a very high pressure until it reaches the injector block, in which the injection or atomising pressure is furnished by a powerful spring. This being so, the external fuel system operates under low pressure, and the use of a fuel distributor on the cylinder head does away with external fuel piping, giving the engine a neat appearance. As our illustrations indicate, the fuel injection mechanism and valves may be easily inspected by removing a light cylinder head casing. With regard to the engine casing, it is of the monobloc pattern with detachable cylinder heads embracing two cylinders. Separate liners are fitted, with the usual means for expansion at the bottom ends. The crank shaft deserves particular mention; it is made from a 40-ton steel and is oil tempered. For ease in assembly it is made in two parts with a centre coupling. The shaft is carried in three main bearings, each of large diameter, two of the roller type and one of the ball bearing pattern. The cam shaft is accommodated within the crank case and is driven by skew gearing from the crank shaft at the end opposite the fly-wheel. The same gear drive also works a dynamo and starting equipment when these are fitted. The lubricating oil is collected in the base-plate sump and is delivered to the bearings and running parts by a rotary pump of the gear type, while the connecting-rod bearings, the cylinder walls and the cams are all lubricated by splash, the surplus oil draining back to the sump. The engine we have described has a fuel consumption of 0·46 lb. per B.H.P. hour and the consumption of lubricating oil is, we understand, only 0·04 lb. per cylinder per hour. For starting the engine a small air-cooled petrol motor coupled to the fly-wheel by a Bendix drive may be used, or alternatively, a small electric starting motor. We reproduce in Fig. 102 torque and horse-power curves for a six-cylinder high-speed Blackstone engine with automatic timing gear.

Norris, Henty and Gardners, Ltd.

On the stand of Norris, Henty and Gardners, Ltd., of 115, Queen Victoria-street, London, a wide range of Gardner high-speed vertical four-stroke oil engines operating on the airless injection principle were shown. The largest of these high-speed engines was a six-cylinder marine unit with a designed output of 57 B.H.P. at 1000 r.p.m., which was exhibited coupled to a Thornycroft reverse gear. A view of this type of engine, without, however, the marine reverse gear, is reproduced in Fig. 111 on page 352. Other sizes in the same series included a four-cylinder 38 B.H.P. engine direct coupled to a Newton generator and mounted on a common bed-plate, while a two-cylinder marine type engine with a Gardner conic reverse gear was also displayed. The generator set was shown in operation, and it effectively demonstrated the quiet running of the engine.

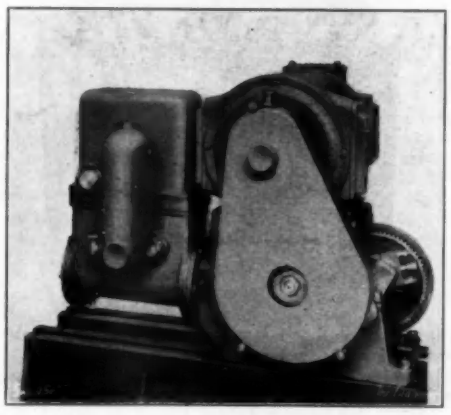


FIG. 103—WATER PUMP—GARDNERS

The largest exhibit on the stand was a 96 B.H.P. two-stroke Gardner vertical marine heavy oil engine designed to run at 370 B.H.P. with airless injection, while a smaller 14½ to 17 B.H.P., 360 r.p.m. engine of horizontal pattern was also on view.

We illustrate in Fig. 103 a new type of Gardner double-acting water pump for deck or general service, which is electrically driven and has been specially designed for duties which favour separate electrically driven units. As Fig. 103 indicates, the pump is motor driven by a chain and gearing. It is complete with an air vessel and a relief valve and is a very compact unit. The pump has a bore of 3½in. with a stroke of 5in. and, working on the double-acting principle at 160 r.p.m., it is designed to deliver 54 gallons of water per minute against a head of 50ft. The same pump can also be used in conjunction with marine auxiliary engine sets for either general service work or bilge pumping.

Hopkinsons, Ltd.

There was a wide variety of exhibits on the stand of Hopkinsons, Ltd., Huddersfield, of the class associated with the firm's name. It comprised valves of all kinds, including one of the 9in. valves for the new Battersea power station of the London Power Company. Hopkinsons are supplying fifty-three of this size of valve alone. They have cast steel bodies and will control steam at a pressure of 650 lb. per square inch and 875 deg. Fah. Each valve is operated by an electric motor with a push-button control, and has a by-pass. There were also steam traps, thermostatic regulators, power-house instruments and boiler mountings.

The feed water regulator, which we illustrate in Fig. 104, is a development of the inclined thermostatic tube principle. As will be seen, there are two tubes arranged in the form of an X, but not connected

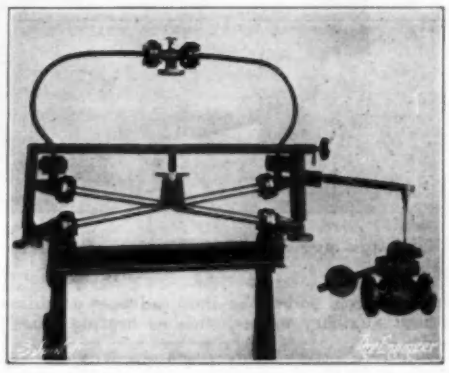


FIG. 104—FEED WATER REGULATOR—HOPKINSONS

together at the intersection. At the bottom they are attached to castings with branches for connection to the water spaces of the boiler. The top ends have corresponding connections for the steam space, by means of the bow-shaped copper pipe. The top casting on the left is pivoted to a rocking lever, which swings on the bottom casting. This lever is connected by a link with another on the right. A bell crank is pivoted in this lever and is also connected with the top casting of the other tube. This bell crank is used to operate the feed check valve. It will be seen that the expansion and contraction of the pipes due to change of temperature as the water level rises and falls is combined at the bell crank and, consequently, a big movement is obtained with a compact apparatus.

There were also on this stand some oil purifiers of the centrifugal and tank types, and two models of pressure feed lubricators with twelve and thirty-two feed points respectively.

Aster, Ltd.

A new type of airless-injection, heavy-oil engine specially designed for hand starting was exhibited on the stand of Aster, Ltd., of Dering House, Bond-street, London, W. 1. The engine is made in three, four and six-cylinder units, with a bore of 120 mm. and a stroke of 150 mm., and designed outputs of 27–43 B.H.P., 38–60 B.H.P. and 60–95 B.H.P. at 1000 r.p.m. to 1600 r.p.m. Fig. 110 on page 352 shows the four-cylinder model. The crank case, which is mounted on a bed-plate containing the oil sump, is a single casting in which the cylinder liners are housed. The main bearings, one between each throw of the crank shaft, are carried in webs which are cast integrally with the crank case. As the webs of the crank shaft are circular in shape and form the main bearing journals, a very short engine is obtained, with a stiff crank shaft. The fly-wheel flange is forged in one piece with the shaft, and the design is so contrived that the drive can be taken from either end of the engine. Both the crank shaft and also the steel connecting-rods are carefully balanced, and the design of these parts is such that the piston, complete with the connecting-rod, can be withdrawn upwards through the cylinder. The inspection doors on the face of the crank case may be noted, and these give unobstructed access to the running parts. Special cylinder liners of centrifugally cast high-tension cast iron are used. The cylinder head is a single casting, which carries within it the vertical

inlet and exhaust valves, these being housed in renewable guides. A feature of the head is the "Aster" patented all-machined combustion chamber, with an adjustable volume ante-chamber, making possible two compression ratios. The compression ratio is altered by turning the handles shown at the front of the engine just below the cylinder head casting. The working compression ratio is about 15 : 1, but the compression ratio used for starting is 19 : 1, which is sufficient to give a high enough air temperature to ensure reliable hand-

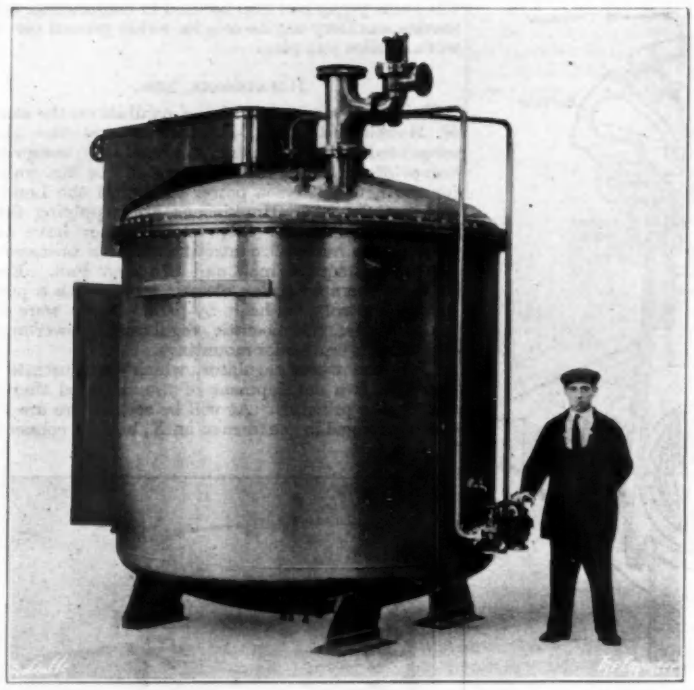


Fig. 105—External Appearance of Comyn Separator—Separators

starting, even under the most adverse conditions, without auxiliary means, such as heating plugs or torches.

Our illustration shows the cylinder head cover removed, and it will be seen that the cam shaft is mounted on the top of the cylinder head and is carried in a separate casting, along with the fuel pumps and their rocker levers, the inlet exhaust and decompression valves and their levers, and the fuel control mechanism. There is a fuel pump for each cylinder, of the Bosch pattern, and a feature of the arrangement is the provision of short fuel pipes, all of equal length, which, it is claimed, overcomes the "surge" effects sometimes noted with long fuel pipes.

The governor is mounted inside the chain wheel on the end of the cam shaft, which is driven from the crank shaft by a triplex roller chain, with a tensioning device. The governor is so arranged that it is directly connected with the fuel pump controls, without the intervention of fulcrum bearings. A hand speed adjustment is provided on the governor, giving a speed range of 800 r.p.m. to 1600 r.p.m. The lubrication is on the forced feed principle, with a gear-type of oil pump, while a cooling water pump also forms part of the standard equipment. For starting up the engine either an electric starter or an air motor driving the fly-wheel through a Bendix gear, can be fitted. The fuel consumption is less than 0·5 lb. of oil per B.H.P. hour.

The firm also showed examples of its range of vertical four-stroke cycle, petrol and paraffin engines, which are built in sizes up to 70 B.H.P.

Separators, Ltd.

Since the introduction of the Act preventing the discharge of oily bilge water over the side of ships, several types of oil separators have been put upon the market, each having particular characteristics. An interesting type is the Comyn separator, made by Separators, Ltd., of Cunard Building, Liverpool. In the engraving, Fig. 105, and the drawing, Fig. 106, we illustrate the external appearance and the internal arrangements respectively. It will be seen that the separator consists of a large tank, having baffles of various shapes inside. The mixture of oil and water enters from the top and is passed down into the centre of a nest of spirals. The appearance of these spirals can be gathered from the engraving, Fig. 107. The several spirals start from equispaced points, equidistant from the centre of the container, and each extends through 500 deg. Each has the characteristic that the distance of any point upon it from the starting point is proportional to the angle turned. The distance between consecutive spirals increases uniformly from the centre outwards, so that the conditions for steady motion exist. The mixture enters the spirals in a state of turbulence, but is reduced by

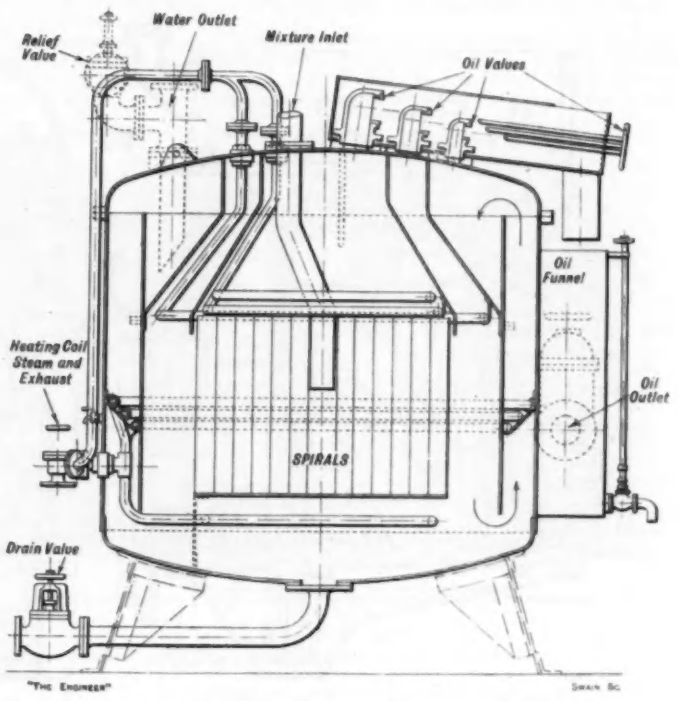


Fig. 106—Section Through Comyn Separator—Separators

loaded further oil may separate out, and this is collected in the annular space between the two baffles to be seen in the drawing. The water sinking to the bottom passes under a baffle and rises again through an annular passage around the exterior of the casing to an annular chamber at the top. As it is possible that a little oil may also collect at the top of this space, the water outlet pipe projects some way into this water chamber, while an oil valve is arranged to draw off oil from the top. Valves are provided to remove the oil from the central and annular oil compartments, and pass it into a container at the side, whence it can be drained off through a check valve fitted some way above the bottom in case any water may collect there. If any water does collect, it can

Fig. 107—The Spirals of a Comyn Separator—Separators

be removed by a small drain cock. For use with heavy oils, steam heating coils are fitted inside the separator and a drain valve fitted to the lowest part of the casing allows any sediment to be removed.

In operation, water, preferably not more than slightly contaminated with oil, is first pumped into the separator, the oil valves at the top being slightly opened to vent the container. As soon as the separator is full, any mixture of oil and water can be pumped through. Owing to the fact that the separator has a very large capacity for oil contained within it, it needs very little attention. Test cocks are fitted, by means of which the depth of oil in each compartment can be gauged.

We had the opportunity of seeing a small separator in operation on the makers' stand. The conditions were more arduous than those it was likely to meet in actual service, in that the water and oil as they passed from the separator dropped freely into a tank with a head of 2ft. or 3ft. The conditions were indeed ideal for emulsification. Yet we observed that the water passing out of the separator was clear and free from oil.

These separators are made in a large range of sizes, and the relative dimensions can, if necessary, easily be adapted to suit the position which the separator is to occupy. The height, for instance, can be reduced, and the diameter increased, without altering the capabilities. Each separator can therefore be designed to be particularly suitable for the conditions under which it is working and its situation.

Perman and Co., Ltd.

With reference to our article on the Kromhout marine oil engines shown at Olympia, which was published in our issue of September 18th, we are informed by Perman and Co., Ltd., that the dimensions given for the 150 B.H.P. engine, namely, 120 mm. bore and 175 mm. stroke, are those for the smaller 9 B.H.P. engine. The cylinder dimensions of the larger 150 B.H.P. engine, which we illustrated, are 265 mm. bore and 350 mm. stroke.

(To be continued.)

Iron and Steel Institute.

No. I.

The Iron and Steel Institute held its autumn meeting this year at Swansea, from Tuesday, September 29th, to Friday, October 2nd, under the presidency of Colonel Sir W. Charles Wright. The hosts were the South Wales Siemens Steel Association, representing local industries. An excellent programme of technical meetings, visits to works and social functions was arranged by the local Committee, under the chairmanship of Mr. Frank J. Rees, J.P., chairman of the South Wales Siemens Steel Association. Mr. Lewis Jones, secretary of that Association, was the Hon. Local Secretary.

Among the works visited during the course of the meeting were the Port Talbot and Margam Works of the British (Guest, Keen, Baldwins) Iron and Steel Company, Ltd.; the King's Dock Tin-plate Works, Swansea (Baldwins, Ltd.); the South Wales Tin-plate Works, Llanelly (Richard Thomas and Co., Ltd.); the National Oil Refineries of the Anglo-Persian Oil Company, Ltd., at Llandarcy; the Swansea Vale Spelter Works of the National Smelting Company, Ltd.; and the Courtybella Works of the Whitehead Iron and Steel Company, Ltd., at Newport. When the meeting opened the members received an invitation to visit still another works—that of Richard Nevill and Co., Llanelly.

The social functions included luncheons at the invitation of the British (Guest, Keen, Baldwins) Iron and Steel Company, Ltd., on Tuesday; Baldwin's, Ltd., on Wednesday; the Anglo-Persian Oil Company, Ltd., and the National Smelting Company, Ltd., jointly on Thursday; and the Whitehead Iron and Steel Company, Ltd., on Friday. There was also a reception and dance at the invitation of

the Mayor and Mayoress of Swansea (Councillor and Mrs. J. Miller), and a dinner by the joint invitation of the South Wales Siemens Steel Association and the Welsh Plate and Sheet Manufacturers' Association.

After a civic welcome on Tuesday morning, a paper entitled "A Study of the Constitution of the Iron-tin Alloys," by Professor C. A. Edwards and Mr. A. Preece, was presented. The following summary of the contents is given by the authors.

IRON-TIN ALLOYS.

(1) The iron-tin equilibrium diagram shows the existence of three compounds :—

(*a*) Fe_2Sn—which is stable between 760 deg. Cent. and 900 deg. Cent., but can react with tin at 800 deg. Cent. to produce the compound FeSn.

(*b*) FeSn—which is stable at all temperatures below 800 deg. Cent., but reacts with tin below 496 deg. Cent. to produce the compound $FeSn_2$.

(*c*) $FeSn_2$—which exists below 496 deg. Cent., and when heated above that temperature breaks down into FeSn plus a tin-rich liquid.

(2) A sample of $FeSn_2$ has been prepared in a very pure state.

(3) The thermal transformations at 760 deg. Cent. and 800 deg. Cent., which Wever and Reinecken attributed to polymorphic changes occurring in $FeSn_2$, are shown to be in no way connected with $FeSn_2$, but are due respectively to the decomposition and formation of the compounds Fe_2Sn and FeSn.

(4) No evidence could be obtained of the existence of Fe_2Sn, which Wever and Reinecken show in their diagram. The evidence of the present work goes to demonstrate the non-existence of this compound.

(5) The present diagram shows the existence of a range of limited miscibility, and in this respect agrees with that of Isaac and Tammann. Wever and Reinecken's diagram shows no limited miscibility range.

(6) The solubility of tin in solid iron increases with increasing temperature up to 760 deg. Cent., and then becomes less as the temperature is further raised to the melting point of iron.

Professor J. H. Andrew (Royal Technical College, Glasgow), discussing the practical application of the work, asked whether, as the result of it, the authors had derived any information pertaining to the actual practical process of tinning plates. For example, could they recommend a definite temperature for tinning, had they any information with regard to the particular constitution of the iron/tin line in a tinned section, and, further, did the time factor make much difference in the actual alloying in the boundary between iron and tin in the tinning process ?

Mr. E. H. Saniter (Vice-president) said that in a piece of steel containing 0·5 per cent. tin, with the tin existing as Fe_2Sn, the latter was stable between 760 deg. and 900 deg. Cent. He asked if 900 deg. Cent. was the melting point, or whether the compound was decomposed into some other compound at that temperature.

Professor C. O. Bannister (Liverpool University) asked whether the authors had left out of consideration the existence of the gamma/delta range in the solid solution of the alloys dealt with.

Professor Edwards, replying to the discussion, said, as to the practical bearing of the work described, that the authors had very pronounced views in certain directions, but preferred to postpone any announcements until they had obtained more evidence. As to the proper temperature of tinning, that was indicated very slightly, but he confessed that those actually engaged in the industry knew much more about it than he and Mr. Preece were able to tell them so far. Certainly the compound $FeSN_2$ had a very definite bearing on some of the important practical problems encountered in the tin-plate trade ; there was no doubt that it had a very direct bearing on the mottled appearance of tin-plates. Replying to Mr. Saniter, he said that small quantities of tin which might accidentally get into the steel charge existed in solid solution. The exact way in which one should look upon its existence in solid solution was a very delicate question. There was a possibility of a divergence of views which, perhaps, it would not be profitable to discuss ; but if compounds did exist in solid solution, the compound which existed in that solid solution would be Fe_2Sn. To Professor Bannister he replied that the authors had intentionally left out the gamma/delta loop because their observations had not covered that range of composition. They had to turn their attention to that from a purely academic point of view in the future.

A paper on "The Diffusion of Tin into Iron, with Special Reference to the Formation of Columnar Crystals," was then presented by Professor Bannister and Dr. W. D. Jones.

DIFFUSION OF TIN INTO IRON.

For the work described by the authors, cylindrical containers were prepared by cutting 2in. lengths of Armco iron, 1in. in diameter. In each a cavity was drilled, ¼in. in diameter, to within ¼in. of the bottom, the lower end of the cavity being cut square. Each cavity was drilled and threaded to take a ¼in. bolt, and in each case 10 grammes of high-quality tin was poured into the cavity. In this way a good surface contact was made between the tin and the iron, and freedom from air bubbles was assured. A bolt was inserted halfway down the cavity. After heating the prepared cylinders for the desired time at the requisite temperature and cooling down, they were sawn through transversely ¼in. from the bottom, and in some cases longitudinally in addition.

After the examination of a large number of specimens it was found possible to divide the alloys produced into three main classes, according to whether they had been heated (i) below 900 deg. Cent., (ii) between 900 deg. Cent. and approximately 1100 deg. Cent., or (iii) above 1100 deg. Cent. Examples of these classes are discussed in the paper.

(i) A prepared cylinder was heated at 800 deg. Cent. for three hours and slowly cooled in the furnace. On examination of a polished and etched section the inner iron edge was found to be unchanged, the equiaxed ferrite crystals persisting to the edge. The interior of the cavity was coated with a layer of the compound $FeSn_2$, forming a broken fringe on the micro-section adjacent to the interior alloy, which consisted mainly of tin in which occasional masses or dendrites of $FeSn_2$ were found. No evidence of diffusion of tin into the iron was found.

(ii) A similar cylinder charged with tin was heated at 1050 deg. Cent. for twenty-four hours and slowly cooled in the furnace. On preparing and etching a section after this treatment a band of columnar crystals was found to commence at the tin interface and to pass for a short distance into the main mass of iron. It is shown that this band of columnar crystals consists of solid solution of tin in iron, and is an effect of diffusion. In every case this columnar structure has only been produced on heating above the Ac_3 point.

In this case also a fringe of the compound $FeSn_2$ adheres to the iron interface ; the interior is filled with tin containing rather more compound than in the previous case, chiefly as isolated dendrites.

Evidence has been obtained that diffusion commences as soon as the bomb reaches the necessary temperature and before the tin is saturated with iron. This evidence was obtained by heating a charged bomb for ten minutes only at 1000 deg. Cent.; on examination the commencement of columnar growth was found, and microscopical examination showed that the tin contained only a few dendrites of the tin-iron compound.

(iii) A similar experiment to the above two was carried out by heating a charged cylinder at 1150 deg. Cent. for five hours. The band of columnar crystals was still formed where the tin diffused into the iron. The microstructure of the interior alloy consisted entirely of dendritic masses of the compound $FeSn_2$ and solid solution.

The discussion, in which only Mr. Saniter and Professor Edwards took part, turned mainly upon the problem of columnarisation.

The next paper was one on "The Effect of Molybdenum on Medium-carbon Steels Containing 1 to 2·5 per cent. of Manganese," by Mr. G. Burns.

MOLYBDENUM IN STEEL.

The effect of molybdenum on the mechanical properties, susceptibility to temper brittleness and tendency to mass effect, of steels containing 1·3 per cent. and 2·3 per cent. of manganese has been investigated.

In the steels containing 1·3 per cent. of manganese, as normalised, the addition of molybdenum up to 0·3 per cent. produces little improvement in the mechanical properties that could not be obtained equally well by an increase of the manganese or manganese and carbon content. It has, however, a marked beneficial effect on the steel in the hardened and tempered condition.

The addition of 0·15 to 0·25 per cent. of molybdenum reduces the tendency to temper brittleness, and causes more uniform hardening throughout the thickness of a section.

In the steels containing 2·3 per cent. of manganese the addition of 0·5 per cent. of molybdenum almost eliminates the susceptibility to temper brittleness, and gives mechanical properties approximating to those of nickel-chromium-molybdenum steels in the oil-hardened and tempered condition.

Mr. J. A. Jones said that the steel dealt with in the paper, particularly plain manganese steel, was receiving a great deal of attention in this country and America. The limitations indicated regarding the susceptibility to mass effect and temper brittleness were realised, but in spite of that limitation the steel certainly had wide applications. There might be a certain amount of difficulty in cooling sections quickly from a tempering temperature, but the masses of nickel-chromium steel that were cooled quickly from the tempering temperature with very little difficulty seemed to suggest that a steel with a high manganese content and with 0·3 to 0·35 per cent. carbon might also be treated in the same way without a great deal of difficulty as regards warping. Of course, as Mr. Burns had stated, the difficulty might be overcome by adding molybdenum, but the condition of the industry was not such as to allow what was called a cheap steel to be made more expensive by the addition of an alloying element such as molybdenum ; for small sections particularly, a plain manganese steel, oil hardened and tempered, gave remarkably good results. He agreed that mass effect in a steel of that composition came into prominence at fairly small section, and he had found that a steel with 0·34 per cent. carbon and 1·24 per cent. manganese, oil hardened and tempered, showed a very marked drop in tensile strength when there was an increase in size from a bar of ⅝in. diameter to ⅞in. diameter. That meant that the drop in tensile strength corresponded with an incomplete hardening, which showed up after tempering. But in the lower tensile range—say, in the 45-ton range—the properties of a steel of that kind were remarkably good. Adding molybdenum to a steel of the same composition would push that mass effect, as marked by the drop of tensile strength after tempering, to a size between 1in. and 1¼in. diameter, thus showing the beneficial effect of molybdenum ; when molybdenum was added, remarkably good test results could be obtained with sections of the order of 3in., 4in., or 5in.

Mr. Jones also asked for information concerning tests on large sections of steels containing manganese and molybdenum, after normalising. It was pointed out that when molybdenum was added to a manganese steel, as tested in the normalised condition, the benefit, if any, was very slight, and when the molybdenum content was increased to about 0·3 per cent., comparatively poor test results were obtained. It was fairly definite, from the results given in the paper, that a steel with 0·32 per cent. molybdenum and 1·3 per cent. of manganese was entering into the air-hardening range. Tempering the steel might have a beneficial effect on its properties, but it intro duced additional heat treatment.

Commenting on the author's statement that none of the steels containing 1·3 per cent. of manganese was hardened satisfactorily by quenching in oil from any temperature between 820 deg. and 900 deg. Cent., he questioned the word "satisfactorily," and said it all depended on the uses to which the steels were to be put. He favoured the substitution of the word "completely." Sections of a plain manganese steel, oil hardened and tempered, gave tests in the 45-ton range which were satisfactory from the point of view of the use to which they were put.

Professor J. H. Andrew (Royal Technical College, Glasgow) contended that molybdenum might be added to many alloy steels, and give rise to very excellent properties, and suggested that the reason for the improvement brought about by it was to be found in the thermal curves. The Ar_1 point was lowered with each addition of molybdenum, and when the Ar_1 change point was lowered there was a finer pearlitic structure and finer dispersion of the carbide. For that reason he suggested that molybdenum might be tried in many other alloy steels.

Mr. Burns, replying, could not say whether the addition of molybdenum would give better properties in large sections normalised, inasmuch as the particular steels dealt with had been available to him only in quite small sizes. With regard to some of the steels being somewhat air hardened on normalising, he said he had carried out some further tests on a piece normalised at about 830 deg. and tempered at 550 deg., and in all cases the elastic limit had risen very considerably, about 4 tons per square inch. They all appeared to have air hardened slightly.

Mr. R. Harrison then presented a paper on "The Influence of Silicon on Nickel Steel."

SILICON IN NICKEL STEEL.

The investigation described in this paper deals with nickel steels suitable for various constructional purposes, in which it is customary to limit the amount of silicon to 0·3 per cent. Its object was to determine the effect on nickel steel of silicon up to about 1 per cent., and, if the results were of sufficient promise, to extend the work to steels of higher silicon content. There is no reason to anticipate a sudden change in the character of the effect of silicon, since the structural constitution remains the same up to at least 3 per cent. of silicon. The second part of the investigation was not proceeded with, however, since the work completed revealed no probable advantage to be expected from the increased silicon content.

The effects of silicon and of manganese on the critical ranges of a steel containing 4 per cent. of nickel and 0·4 per cent. of carbon are summarised in Table I.

TABLE I.

	Raising of the point for an increase of silicon of 1·0 per cent.		Lowering of the point for an increase of manganese from 0·4 to 0·75 per cent.	
	Mn, 0·4 per cent.	Mn, 0·75 per cent.	Si, 0·05 to 0·2 per cent. (average).	Si, less than 0·1 per cent. (Jones).
	Deg. Cent.	Deg. Cent.	Deg. Cent.	Deg. Cent.
Ac_1	18	15	6	5
Ac_3	5	10	5	4
Ar_3	24	13	33	32
Ar_1	16	14	20	27

The general effect of silicon is to raise all the points, and its influence is approximately proportional to the amount present in the steels examined.

Hardness tests were made on small pieces—1 × ½ × ½in.—cooled from 850 deg. Cent. at different rates through the critical range. The results of the tests are given in Table II.

TABLE II.—*Brinell Hardness Numbers of Steels Cooled at Different Rates.*

Steel No.	Silicon, per cent.	Average rate of cooling between 850 deg. and 500 deg. Cent.				
		Water, 100 deg. Cent. per sec.	Oil, 16 deg. Cent. per sec.	Air, 4 deg. Cent. per sec.	Furnace.	
					½ deg. Cent. per sec.	1/60 deg. Cent. per sec.
1	0·05	551	521	210	185	160
2	0·21	519	503	215	196	172
3	0·40	560	547	237	210	188
4	0·63	571	542	251	223	203
5	0·07	559	550	255	211	192
6	0·21	512	477	301	234	211
7, 8	0·38	548	525	297	235	219
9, 10	0·66	551	542	402	243	221
13	0·87	573	558	355	248	235

The paper gives also the results of several tests on mechanical properties.

Mr. J. A. Jones suggested that the value of the paper to the industry would have been enhanced if the author had selected a nickel content more within the range of nickel content that the steel industry could afford to use in these hard times ; for example, about 3 per cent. of nickel. He did not mean to suggest that the results as to the effect of silicon on a 4 per cent. nickel steel could not be interpreted in respect of lower content ; they certainly could. An important consideration was whether one could substitute for part of the nickel—which was an expensive element—something cheaper. The author had made it fairly clear that it could not be replaced by silicon. Another question was whether there was any difference in the mechanical properties of a nickel steel containing, say, under 0·15 per cent. of silicon and a steel of the same nickel content but containing a little more than the usual working range for silicon, say, about 0·3 per cent. Was anything lost in mechanical properties by working to a silicon content below 0·15 or 0·20 per cent., and was there likely to be a gain by increasing the silicon above the usual range of 0·3 or 0·35 per cent.? Many people had regarded silicon as having a deleterious effect on the transverse strength of steel, and he asked if Mr. Harrison could interpret his results to confirm that opinion or otherwise. As to the effect of silicon on the Ar points, he said that figures in the paper showed a rise of the Ar_3 points with increase of silicon content, even in the presence of high manganese. Com-

menting on the author's statement that the steels investigated contained not more than 0·87 per cent. of silicon, but that they had given no indication that any specially good mechanical properties were likely to be obtained by increasing the silicon to 1 or 2 per cent., Mr. Jones said he was not sure that that conclusion was really justified. The effect of larger silicon content on steel could hardly be predicted from experiments carried out with silicon contents up to 0·87 per cent. He would not like anybody who wished to investigate the production of improved steels to accept that conclusion as final, for he believed there was a possibility that at somewhere about 1½ or 2 per cent. silicon there might be quite a marked effect on the properties of a nickel steel, though it might not be a 4 per cent. or a 2 or 3 per cent. nickel steel.

Mr. Harrison, replying, said he had chosen a 4 per cent. nickel steel on the assumption that what was true of that was more than probably true of a 3 per cent. nickel steel, and from the steady nature of the change due to increasing the silicon content that was probably so. He did not consider that the substitution of silicon for nickel would be worth while; the effect on the properties was so small, and undoubtedly there were disadvantages in high silicon content, so that it would be much better to leave the nickel alone. As to the effect of the lower ranges of silicon, there was a very slight improvement, but nothing to take any notice of. From zero to 0·8 per cent. silicon the properties of the steel increased steadily and uniformly. As to the effect of silicon on the critical points, he said that the change in respect of the critical points was clearly due to increasing silicon content. He would not like to make a definite statement that still higher silicon contents than he had used would not lead to pronounced improvement. He had stated that "there was no indication" that any specially good mechanical properties were likely to be obtained by increasing the silicon content to 1 or 2 per cent. Constitutionally, he believed, up to some 4 per cent. of silicon there was no change in the diagram, and that gave some backing to the opinion he had expressed.

The meeting then adjourned until Wednesday.

(To be continued.)

The Faraday Exhibition.

No. II.*

When it is remembered that the Faraday Exhibition has been designed to show the outcome of Faraday's work as well as what he actually did, and that it covers his chemical and electro-chemical investigations in addition to his electrical activities, it will be realised that any attempt to describe the show in a few brief articles must fall a long way short of actualities. There can be little doubt that the majority of men who have long been associated with electrical work have found the historical side of the Exhibition the most attractive, for it takes the mind back to the days when pleasure was derived from the making of primary batteries, spark coils, and frictional machines, and when there were no superpower stations or "grids." The sight of such things as Faraday's induction ring, his helix and magnet, the apparatus he employed in his experiments on specific inductive capacity, the frictional machine constructed by Nairne for Sir Humphrey Davy, and many other pieces of early experimental apparatus, makes one marvel at the rapid strides of electrical science and wonder what the future holds in store.

All these early relics have the merit of extreme simplicity and are easily understood, whereas many of the things that have been derived from them are highly complicated, and although essential in these busy days, they are to many less fascinating than the apparatus used by Faraday and other early electrical investigators. The replica of Faraday's laboratory which has been arranged in the King's Hall of the building is an exhibit which few who have seen it will readily forget, and which ought not to be allowed to pass out of existence. Although the old stone-flagged laboratory, which was really little more than a basement in a pair of houses, has undergone reconstruction on various occasions, there were sufficient records to enable it to be reproduced, and in view of the clever work that has been put into it and the interest it has aroused, we suggest when the Exhibition closes on Saturday steps should be taken to install it permanently in some suitable Institution.

On behalf of the B.E.A.M.A., Mr. Robert W. Paul has brought together an excellent collection of electrical instruments, ranging from those used in early days to those employed at the present time. Limitations of space have made it necessary to exclude all instruments that are concerned with the measurement, by electrical means, of mechanical forces, velocity and acceleration, also those concerned with the measurement of temperature, the acidity of liquids, the composition of mixed gases, and those employed for the measurement of many other physical quantities. Nevertheless, it was deemed advisable to include as far as possible instruments that were invented before the time of Faraday's researches, and which were therefore available for his use. The task of getting this collection together was one of no mean order. Difficulties were met with, in the case of certain instruments, in fixing the date of introduction and even the name of the inventor. But every effort has been made to provide authentic information, and where replicas have had to be constructed, care has been taken to ensure that, as far as practicable, they correspond with the original.

*No. I. appeared September 25th.

The purpose of the exhibits is to illustrate the manner in which electrical instruments have been developed from the discoveries of certain electrical principles. In 1824, for example, Arago discovered that a conductor could be set in motion by the motion of a neighbouring magnet, and the model, Fig. 10, demonstrates this principle. On spinning the magnet

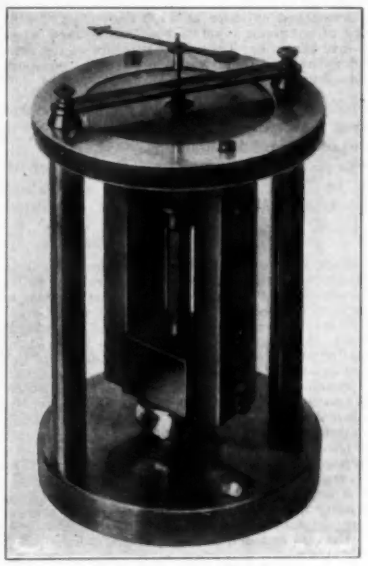


Fig. 10—Arago's Rotating Field Model

to be seen between the two vertical columns, a horizontal disc or needle revolves with it. Fifty-five years later, *i.e.*, in 1879, W. Baily made the model illustrated in Fig. 11, for showing that a metal disc pivoted above the ends of electro-magnets could be rotated by changing the polarity of the magnets by means of the rotary switch or commutator, to be seen on the left. This was followed, in 1889, by the invention of A. Wright and others (patent No. 1480/89) of a meter with the eddy current effect applied to part of the pole pieces so as to produce a rotating field and to cause a shaft to rotate. The main claim in the patent specification reads: "A meter in which an A.C. electro-magnet has poles (wholly or partly surrounding a metallic armature), which owing to their being made more or less solid by reducing their laminations or surrounding them with closed coils, prevent the waves of magnetism reaching their whole extent simultaneously and so cause a virtual shifting or rotation of the field which a magnetic body or armature will tend to follow." A model of Wright's meter, which is followed by a collection of modern service meters working on this principle, is shown in Fig. 12.

The following classes of instruments operate by a

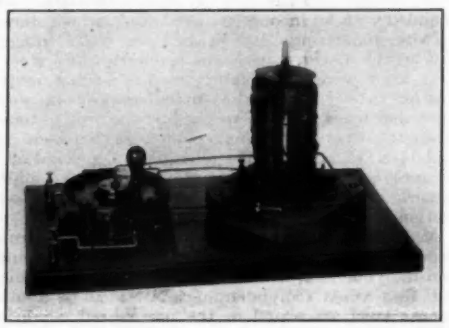


Fig. 11—Baily's Rotating Field Model, 1879

force which gives rise to a movement, or tendency to movement, many of them being arranged so that visitors can make them give a deflection:—Electrostatic instruments, depending on the force between two electrified conductors, as in the case of the torsion balance invented by Coulomb in 1775, and the electrostatic balance used by Volta in 1780.

This series comprises, among the latest examples, an electro-static voltmeter of the Ionic-Wind type, devised by Professor Thornton.

The voltmeter is described in a paper by Dr. Thornton, M. Waters and W. G. Thomson, published in the April issue of the *Journal* of the Institution of Electrical Engineers. Briefly, the electric wind observed in the neighbourhood of a highly charged point in air is caused by the repulsion of ions produced at the surface of the point by the intense field. In their movement the ions collide with uncharged molecules of air, thus giving to them velocity, and, in effect, causing a wind from the point. When the field is alternating, this wind has two components, a steady stream of air and a movement of alternation in synchronism with the field. The effect is observed at both high-tension and earthed poles. By enclosing the latter in an insulating vessel and using as the electrode a bent wire with suitable anti-corona shields, the wire is found to be cooled by the alternating component of the wind, and this cooling is remarkably

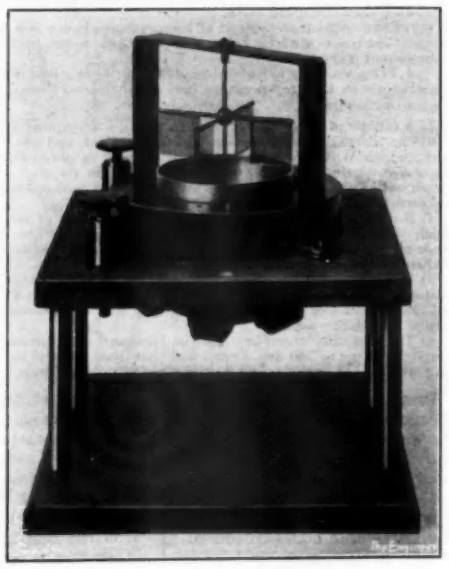


Fig. 12—Wright's Meter Model

steady. The "ionic wind voltmeter" is based on this principle and is designed to indicate the voltage of any system above a few thousand volts up to 300 kV by making the earthed electrode part of a hot-wire bridge, as shown in Fig. 13. The balance of the bridge is disturbed when the field is applied, and the out-of-balance bridge voltage is a measure of the high-tension voltage, which can be observed at any distance. The diagram, Fig. 13, relates to the apparatus shown at the Exhibition. H T are the high-tension lines, to one of which a sphere is connected; I L is the ionic lamp, connected in the hot-wire bridge, which is earthed at the point E, as shown in the small

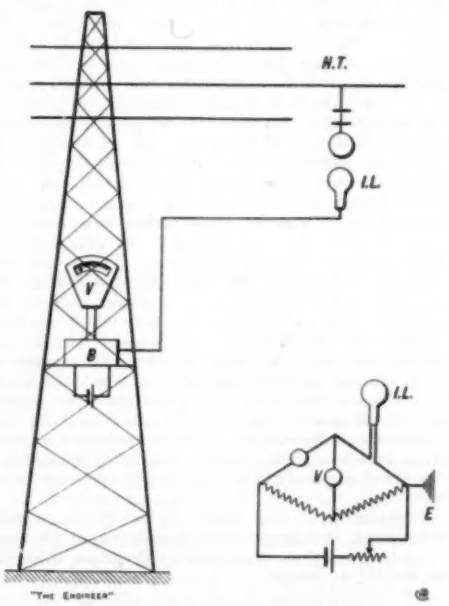


Fig. 13—Ionic Wind Voltmeter

diagram. Movement of the ions in the lamp cool the filament and throw the bridge out of balance.

The electro-magnetic instruments of the moving magnet type form a series beginning with a replica of Oersted's deflected compass, and concluding with the latest type of high-sensitivity reflecting astatic galvanometer, with quartz suspension and mumetal shield. Electro-magnetic moving iron instruments start with the discoveries of Davy in 1820 and Sturgeon in 1824, and conclude with power factor meters and frequency indicators, and other modern instruments.

Electro-magnetic moving-coil instruments form one of the most important series, beginning with Oersted's experiment showing that a conducting loop, short-circuited on a single Voltaic cell and suspended on a fine wire, is repelled by a magnet. Davy's discovery that a pool of mercury carrying a radial current would rotate in the presence of a magnet,

and Arago's discovery (1824) that the speed of a rotating copper disc is reduced by bringing a magnet near it, led up to the development of the modern D.C. service meter. The so-called electro-dynamoscope of Sturgeon (1824), developed into the modern form of moving-coil instrument by Varley (1856) and Davies's long-scale instrument (1893), as well as the highly sensitive galvanometers used in the modern laboratory, are displayed.

The electro-magnetic or dynamometer instruments are introduced by a model of Ampère's original

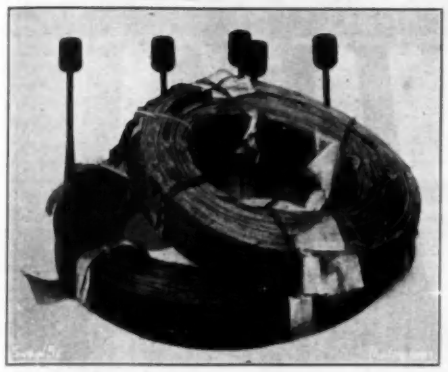


FIG. 14—HENRY'S INDUCTION COILS, 1835

experiment, showing the force between two parallel conductors, and, together with other electro-magnetic instruments introduced since that time, the precision wattmeters of Drysdale, Dudell, and others, are shown. Next come the rotating field induction type instruments to which we have already alluded.

Most of the instruments in the remaining classes are of a stationary character, and are generally used in conjunction with one or other of the preceding instruments. There are thermal or hot-wire instru-

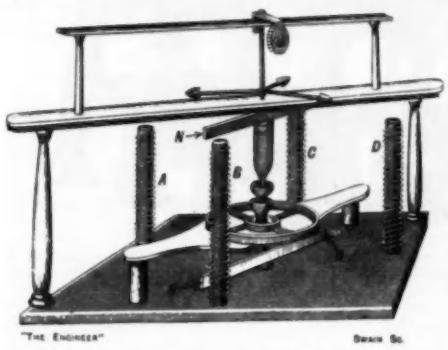


FIG. 15—STURGEON'S ELECTRO-MAGNETIC ENGINE, 1832

ments, based on the discovery of Joule in 1839, that the rate at which electrical energy is dissipated in the form of heat in a conductor, depends on the current flowing and the resistance offered to its passage, and electrolytic instruments, depending on Faraday's discovery that the amount of decomposition in a liquid compound caused by passing a current through it, is proportional to the quantity of electricity passed. Besides old and modern instru-

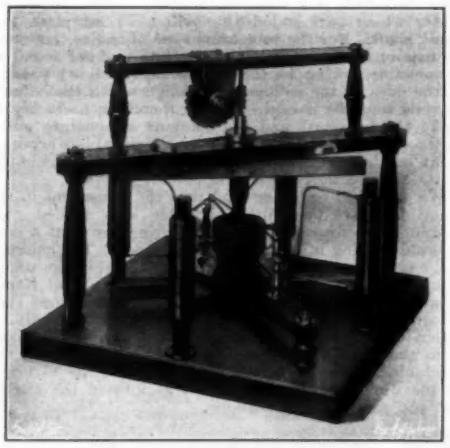


FIG. 16—STURGEON'S ELECTRO-MAGNETIC ENGINE MODEL

ments for the measurement of resistance, including the original Wheatstone's bridge, there are potentiometers, capacities and inductance apparatus, and the actual coils used by Henry—Fig. 14—in his experiments of 1835. There are also examples of old and modern transformers, including those for precision measurements and those for use at radio frequencies.

One thing that Mr. Paul has apparently done in the course of his investigations in connection with this instructive collection of instruments is to establish the fact that, without doubt, Sturgeon was responsible for the first commutator. In the autumn of 1832 Sturgeon constructed an electro-magnetic engine, which is described in his book "Scientific Researches in Electricity, Magnetism, Galvanism," published in 1850. From this volume the drawing, Fig. 15, has been reproduced, whilst Fig. 16 shows a model that has been made from the drawing and which is to be seen on the electrical instrument stand. Sturgeon describes his engine in great detail, but what it really amounts to is four vertical electro-magnets, A, B, C, D, mounted on a wooden base. Attached to the centre spindle are two permanent magnets, with the poles arranged N.S. and S.N., as shown. Just above the lower magnet there is a fixed horizontal commutator, and above that revolving brushes, which serve to reverse the current in the electro-magnets, the current being supplied to the brushes through conductors dipping into mercury cups, which also revolve with the vertical spindle. It is obvious that, if, after the current has been switched on, the magnets are given a swing then owing to the attraction and repulsion of the magnets, the machine will continue to rotate, and here we have an electric motor.

(To be continued.)

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE PROBLEM OF WASTE.

SIR,—To engineers and scientists the problem of waste should be a most intriguing one. Men are continually achieving new and immense efficiencies in the productive processes, and vastly increasing their knowledge of natural law. Yet, as one looks back, one is forced to realise that the average standard of life, measured in equivalent money wages, increases but slowly, if at all. The standard fluctuates, now advancing and now receding, yet always tending to return to a mere subsistence level. Populations grow bigger and bigger. But, in the long view, there is little real advance. It seems doubtful if the average standard of life in England has increased by as much as two-fold since early Tudor times, when, according to Thorold Rogers, a peasant could, by working fifteen weeks a year, provide himself and his family with ample food.

The intervening years have, however, witnessed the astonishing development of science, and of highly efficient socialised-production in great factories. Our potential productivity per worker has increased by more than a hundred-fold since early Tudor times.

In 1916 Lord Leverhulme, in his preface to Professor Spooner's book on "Waste," stated that, with the knowledge of technique then existing, *one hour's work a week* by each adult was adequate to provide the community with all the food, clothing and housing it required. Since he wrote, the introduction of the combined harvester has increased the productivity of the wheat field worker by some seventy-fold, and similar, though less spectacular improvements in productivity have been achieved in connection with the production of clothes and housing.

The rate of communal waste must, therefore, have increased at least fifty-fold since early Tudor times, and it is quite obviously still increasing!

If one considers the ever-increasing disproportion between the increased productivity per worker and the average purchasing power of the mass of our citizens, or the diminishing relation between our total potential productivity and the productivity actually achieved, or the relation between the man-hours worked by producers and distributors and the amount of goods actually produced and distributed *within the producing community*, one comes to the amazing conclusion that every increase in industrial or technical efficiency achieved by the scientist and the engineer is very shortly afterwards approximately cancelled by a corresponding increase in communal waste. Further thought shows us that society, as at present constituted, would cease to function if this was not the case. To such a society as our own, wealth is a toxic by-product which must be eliminated at all costs! Such elimination of wealth by restriction, obstruction, distribution or diversion is a commonplace.

Thus, in England, we have some 2,500,000 unemployed, and the necessary plant for their use. These people, if organised for production at the present average rate of the English worker, are capable each year of bringing into being wealth to the value of at least £500,000,000 sterling for themselves and the community. This is a startling fact when one considers the bug-ridden East End of London, the lousy clothing, the lack of public laundries, or if one considers the squalid smoke-covered cities of the industrial North. Again, much of our foreign trade consists of the exchange of goods for money, which money is largely invested in foreign "securities." These very frequently depreciate and become valueless. One need not detail here our losses in connection with the French and American railways during the last century, or the more recent losses to France, Russia and Australia, or do more than mention our losses in connection with the South Sea Bubble during the eighteenth century. It is sufficient to point out that the total value of the overseas possessions which we hold after 300 years of war, trade and exploitation (£4,000,000,000) is rather less than the value of the war material which we produced during the last two years of the 1914–18 war, when, for the only time in our history, we were allowed to be organised for production. Since the war, our obsessions in this matter of foreign trade have caused us to spend £300,000,000 sterling on our shipping, £200,000,000 of which, at present, lies idle in our costly harbours.

It is a commonplace that many of us aim at preventing the community from purchasing cheap and inexpensive goods from overseas by the imposition of tariffs. Imports of cheap oil and timber are objected to. Germany is still not allowed to pay reparations in kind. We sabotage the splendid engines and ships of our Navy when they are withdrawn from service. We similarly sabotage any large catch of fish, or a bumper crop of potatoes. In these and similar ways we are continually limiting, or trying to limit, the wealth available within the community.

Then again, we allow vested interests to paralyse our production potentialities in a thousand ways. The story of our derelict canals is ancient history. At the present time small but highly efficient power stations are being shut down so that super power stations that can never rival these in efficiency may be brought into being. There is also a proposal to electrify the railways at immense cost. But any proposal to establish a goods clearing house in London, or to increase the useful life of a railway truck beyond the present 3 per cent. of its total life would be immediately negatived. Liquidations, bankruptcies, trade depressions are commonplaces of our economic life. There is also the vast cost of war and the preparation for war, and at the present time wars are mainly undertaken in order to protect foreign trade, which is in itself, except in so far as it exchanges goods for goods, one of the principal causes of communal loss.

In other directions we encourage the proliferation of feeble-minded, criminal and insane stocks instead of reducing or eliminating them, while we do almost nothing to encourage the increase of stocks with high bodily and mental endowments. We make wholly inadequate use of our existing material resources and medical knowledge, so that the comparatively poor human material that we allow to come into existence never reaches the development and communal usefulness of which it is capable.

Just as whole libraries are filled with books dealing with our engineering and scientific efficiencies, so whole libraries could be filled with books dealing with the above and similar communal wastes. It is sufficient for the present purpose to say that estimates made in the several ways that are possible to us tend to show that these communal wastes fritter away about nine-tenths of our activities. If we were ingenious enough to eliminate these wastes we might enter upon the age of endowed leisure of which all workers and sorely pressed taxpayers dream. It is interesting to note that since our existing productive efficiency is, if made use of, more than adequate to supply our needs, the only type of inefficiency which we might reasonably tolerate with complacency is industrial inefficiency. Yet this is the one type of inefficiency that we strive energetically to reduce.

The more immediate cause both of our immense and ever-increasing potential productivity and our failure to make adequate use of it would seem to be the necessity for each industrialist and trader to economise bank credit or cease to function. This necessity causes, on the one hand, the minimum amounts be paid in wages and salaries, while, on the other, it ensures that the efficiency of the organising, productive and marketing processes shall be increased to the highest possible extent. The available purchasing power of the community is thus wholly unable to absorb the potential product, so that our economic system can only function by continually devising new methods of waste.

Why, then, do we so willingly accept this "necessity" which makes impossible the attainment of the finer ends for which we labour? It has been found that individuals who are independent and economically free are difficult to co-ordinate for war purposes, or for ends which do not seem to them to be of value. Engineering employers will remember the difficulty of handling their employees after the war until a lock-out had eaten up their savings.

If we seek scope, security and endowed leisure for all, the basic change that seems desirable is to evolve some method of co-ordinating man's activities other than that based on the scramble for money power. One can envisage a society in which it is illegal or impossible to work for personal money profit, though different rates of remuneration might be paid. It would seem desirable in such a society that the mere maintenance activities—food, clothing, housing, transport, and manufacture generally—should be organised as efficiently as possible on mass production lines, and that each citizen should be liable to serve in the mass production factories. This service need only be a few hours per week or a few weeks per year, and might be made at least as thrilling and as skilled as golf or tennis. In order to occupy the large leisure that would then be available, credits might be issued to competent and freely co-operating individuals to enable them to carry out research, to build great airships or cathedrals, to stage plays, or to engage in any of the other activities that competent, trained and cultured men and women might desire. The pay for engaging in such activities would be the job and its responsibilities and achievements, and not money reward of any kind. In a society in which there was ample wealth and leisure, few would desire to accumulate. There would, of course, be a State organisation to co-ordinate these maintenance and leisure activities. This would naturally arise during the transition period, when men were becoming trained and cultured, and when the feeble-minded, insane and diseased stocks were being weeded out.

It is amusing to compare these things, which are well

within the range of our present knowledge and technical possibilities, with our present forced economy and distress.

September 28th. JOHN L. HODGSON.

THE GRAMPIAN POWER SCHEME.

SIR,—We have read with very great interest the articles which have recently been appearing in THE ENGINEER describing the Grampian hydro-electric scheme, and we were very pleased to see such excellent illustrations on page 222 of your issue of August 28th, of the butterfly valves installed below the bifurcation in the tunnel.

We notice, however, in the description that you refer to these valves as being identical, except as regards their size, with the valves which we supplied for the Maentwrog undertaking of the North Wales Power Company. We feel that we should point out that these valves, although two of them are automatic in operation, are in no way similar to the Maentwrog valves. The Grampian system of valves at this position consists of one isolating butterfly valve, hand-operated, on the upstream side, and one hydraulically operated, automatically controlled butterfly valve downstream, on each pipe line. The automatic valve obtains its operating power from the two pressure accumulators, in which oil and air are stored under pressure.

On the occurrence of excess velocity in the pipe, the tripping paddle is carried forward, releasing the operating valve and admitting oil pressure to the closing side of the cylinder. The capacity of the accumulators supplying this oil under pressure is sufficient for two complete operations of each valve. In the case of the Maentwrog valves, however, you will recollect that they are operated by falling weights.

We mention this point, as the Grampian valves are of particular interest, since we believe they are the first and only installation of their kind in this country.

GLENFIELD AND KENNEDY, Ltd.
E. BRUCE BALL, Jun.

Kilmarnock, September 26th.

THE CAIRO INTERNATIONAL RAILWAY CONGRESS.

IT was decided at the Madrid International Railway Congress last year that the twelfth session should be held in Cairo in 1933. Hitherto, except during the war and post-war years, the Congress has met at intervals of five years, *e.g.*, London, 1895; Paris, 1900; Washington, 1905; Berne, 1910; then, after London, 1925, there came Madrid, 1930. The interval now is to be one of three years, and thus the Cairo meeting will be held in 1933.

In a recent bulletin of the International Railway Congress Association, the list of questions to be discussed at Cairo and of the reporters who are to deal with the questions, was issued. It appears that there will be the usual five sections: (1) Ways and Works; (2) Locomotives and Rolling Stock; (3) Working; (4) General, and (5 Light Railways and Colonial Railways. The list of subjects has, however, been reduced from twenty considered at Madrid to thirteen; three instead of four in sections (1), (2) and (3); two instead of four in section (4), and two instead of four in section (5).

The subjects to be considered in section (1) are: I.: The protection of level crossings in view of modern developments in road traffic. II.: The use of mechanical appliances in permanent way maintenance and in track relaying. III.: The relationship between the vehicle and the track to ensure safety at high speed. In section (2) the reports are to be: IV., Methods to be used to increase the mileage run by locomotives between two repairs, including lifting; V., Electrification; VI., All-metal rolling-stock. One of the papers in section (3) is IX., Automatic Train Control, whilst in (4) there is X., The scientific organisation of work. There are to be thirty-six reports on the thirteen subjects.

English railway officers who are acting as reporters are: Mr. A. Newlands, on subject I.; Sir Henry Fowler, IV.; Mr. H. N. Gresley, VI.; Mr. G. H. Crook, IX., and Mr. E. C. Cox, XI. Mr. A. D. J. Foster, of the New South Wales Government Railways, takes XIII.

SECOND EXTRA-HIGH TENSION ALTERNATOR FOR BRIMSDOWN.

IN our issue of August 28th last we referred to the opening up of the 35,000-volt, 25,000-kW Parsons alternator, after three years' service in the Brimsdown station of the North Metropolitan Electricity Supply Company. The operation of this machine had been so satisfactory that some time ago a second alternator was ordered by Captain Donaldson to work at the same pressure. At the end of last week this new machine completed its running tests at C. A. Parsons and Co.'s works, at Newcastle-on-Tyne. Before these tests the stator windings, which are of the concentric cable type, were submitted to a test pressure of 100,000 volts and the completed rotor was run up to an overspeed of 33 per cent. in the armoured chamber specially built for such trials. In spite of the very high voltage of the machine, the factors of safety, both electrical and mechanical, are, we are informed, as high as in a machine constructed for a lower pressure. Since the first cost of a high-voltage machine is much less than that of an ordinary machine with the necessary transformers to give an equally high voltage, and as the efficiency is at least as great, there would appear to be a considerable future for the principle of direct generation at high voltages. The development of machines of this type is due entirely to British enterprise, as no alternators built for so high a voltage are yet running in any other country in the world.

WELDED STEEL COLUMNS FOR SUBMARINE OIL ENGINES

THE STEEL BARREL COMPANY LTD., UXBRIDGE, ENGINEERS

FIG. 1—HALF COLUMN UNIT BEFORE WELDING ON THE OUTER PLATE

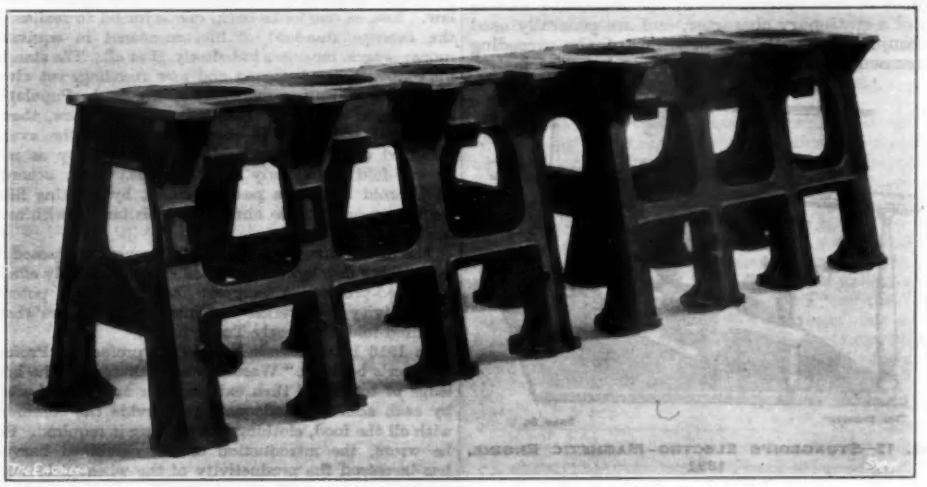


FIG. 2—COMPLETED COLUMNS FOR SIX-CYLINDER OIL ENGINE

Welded Steel Columns for H.M. "S" Class Submarine Oil Engines.

IN the issue of THE ENGINEER for September 18th, 1931, we gave an illustrated description of the 300 B.H.P. six-cylinder Davey-Paxman oil engine with welded steel framing constructed under the patents of Mr. C. H. Stevens, M.I. Mech. E., M.I.N.A., of the Steel Barrel Company, Ltd., of Uxbridge, Middlesex. We are now able to give particulars of the welded steel columns which have been made at Uxbridge under the Stevens patents for the main twin-screw oil engines of H.M. "S" class submarines.

They have been adopted as an alternative to cast steel columns, which, owing to the difficulties experienced with castings of this nature, have to be made in small units and afterwards bolted together. In such a design not only are the main column castings required, but other castings for closing in the crank chamber and housing the lower ends of the cylinder liners have also to be made, and bolted in position. Cast steel columns, therefore, require extra weight for bolted connections and extra machining for the fitted parts.

In the welded design shown in the accompanying illustrations, Figs. 1 and 2, the complete columns for the six-cylinder engine are built up on two monobloc units, which only have one bolted connection at the centre at the arch spanning the central cam-shaft driving gear. As may be clearly seen from Fig. 1, the lower diaphragm plate is welded in position in a single piece, thus forming an oil-tight member separating the crank case space from the cylinder water jackets. This view represents a half column unit before the outer plating was welded on. It will be seen that each column plate is made of two steel plates arranged back to back, which are splayed out to form the column feet and are reinforced and ribbed where the holding down studs pass through.

On the top of the columns there is welded the cylinder head seating plate, and below this there is a single plate, which carries the stresses from the cylinder head bolts. Between these two plates a cylindrical distance piece is welded to house the top end of the cylinder liner. It will be clear from our illustration that these top plates, with the interconnecting distance piece, form a very stiff cross girder.

The outer plates, which are shown in Fig. 2, forming the sides of the columns, are cut from a single steel plate and are welded on to the columns, suitable machining strips for the inspection doors, facing pads and supporting brackets, for the top plate being afterwards added. The design fulfils, it is claimed, the main object of the Stevens patents, which is to ensure that all the working stresses are taken by the steel plates themselves, and that no stresses are carried by the welds.

In the case of the 300 H.P. Davey-Paxman engine, previously referred to, the design of the welded crank case embodied, it will be recollected, a continuous sling plate, which surrounded the cylinder head plate and crank shaft. For the submarine type of engine, however, the use of such a complete sling plate was not found to be possible, owing to the somewhat restricted passage in the deck of the submarine through which the column framing must be passed. It was, therefore, necessary to make the bed-plate and the columns as separate units. In the upper portion of the columns the sling plate arrangement has been retained, whilst the column feet conform to the specification of a second patent.

We are given to understand that the reductions in the scantlings have been found possible with welded steel columns as compared with steel castings, so that a considerable saving in weight has been made. The columns we have described and illustrated were made under Admiralty supervision at the works of The Steel Barrel Company, Ltd., at Uxbridge, and we are informed that a degree of accuracy which it would be very difficult to attain with steel castings was secured, and, apart from the weight-saving referred to, an economy in the machining of the parts was made owing to the accuracy of the dimensions, which greatly facilitated the setting out and machining operations.

A TELEPHONE circuit has been established by the Victorian Electricity Commission over its 132-kV power line between the Yallourn generating station and the terminal station at Richmond in Melbourne. The equipment was supplied by the German Telefunken Company. A high-frequency carrier system is used, the speech current being imposed on, and tapped from, the power line through 5ft. porcelain condensers. Between the latter and the main power transformers choke rejectors are connected to impede the high-frequency carrier current, while allowing the low-frequency power current a free passage. This is the first installation of its kind to be used in Australia.

Railway and Road Matters.

There was a fall from 29,018 in July, 1930, to 26,798 in July last in the number of new motor vehicles registered. The biggest average decrease was in motor cycles; motor cars decreased from 13,448 to 13,076.

It is stated that in view of the probable deficit of £10,000,000 in the trading account of the Canadian National Railways, the Dominion Government is considering the appointment of a Royal Commission to investigate transport problems.

The House of Lords Committee has decided not to proceed with the Humber Bridge Bill this session. The cost of the bridge was estimated at £1,750,000, and a Government contribution of 75 per cent. had been promised. The promoters hope that the Committee's decision means only a temporary postponement, because of the national financial crisis.

The retirement is announced of Mr. I. Kempt, the divisional carriage and wagon superintendent at Glasgow of the London, Midland and Scottish Railway. Mr. Kempt became an apprentice on the Caledonian Railway under Mr. Dugald Drummond and was with that railway until it became part of the L.M.S. system. Many of the older school of railwaymen will be interested in this announcement in that it relates to a son of Mr. Irvine Kempt, for many years the Caledonian superintendent of the line.

Owing to the inadvisability of having any joints in the cable that has to be laid through Merstham Quarry Tunnel in connection with the extension of the Southern Railway electrification from Coulsdon to Brighton and Worthing, the length of cable and the size of the drums carrying it were unusual, as the tunnel is 1 mile 353 yards long. It was therefore decided to close the tunnel against traffic on Sunday, September 20th. On that day an engine drew the wagons carrying the cable drums through the tunnel whilst the cable was slowly paid out. There were five drums and the three heaviest each weighed 13¼ tons.

The railwaymen's unions in Ireland held a meeting in Dublin on September 19th, when a resolution was passed calling for a full investigation and impartial inquiry into Irish transport matters and for the introduction of legislation for State ownership and control of the entire transport system in the Free State. The N.U.R. chief organiser, in proposing the resolution, would appear to have spoilt his case when, after stating that the receipts of the Great Southern Railways Company had fallen from £6,928,000 in 1925 to £5,855,000 in 1930, he added that the expenditure for the same period had been reduced from £6,267,000 to £4,949,000.

The annual report by Lieut.-Colonel Mount on the railway accidents of last year, states that, in addition to the thirteen accidents inquired into by the inspecting officers, four other cases, involving non-passenger trains, were investigated. Of this total of seventeen inquiries, there were fifteen in which the consequent report made recommendations. In six cases the recommendations were wholly adopted; in three they were partially adopted; and in four the advice was not accepted. The recommendations made in the two remaining cases were still under consideration when the report was prepared, and a decision had yet to be arrived at in relation to one of the three reports wherein the recommendations had been partially adopted.

The present year of grace has seen the centenary of two Scottish railways—one in the Glasgow area and one in Edinburgh. Actually, the former line was the fourth railway to be opened in Scotland, being preceded by the Kilmarnock and Troon, brought into use in 1811; the Monkland and Kirkintilloch, opened October, 1826; and the Ballochney, which joined the Monkland Railway, and was opened on July 8th, 1828. The Monkland and Kirkintilloch line ran from the ironworks at Palace Craig, near Old Monkland—west of Airdrie—to the Forth and Clyde Canal at Kirkintilloch, and was built to convey coal from the Monkland coalfield to the canal for transport by water to Glasgow. The railway in the Glasgow area, which was opened in May, 1831, was the Garnkirk and Glasgow Railway. It, like the Ballochney, was connected with the Monkland Railway, and ran from Gartsherrie on that line, through Garnkirk, to Glasgow, where the terminus was in Cleve-street, now part of the St. Rollox mineral yard. The Garnkirk line was 8¼ miles long, cost £40,000 to build and was worked from the commencement by locomotive power. The line in Edinburgh, the centenary of which occurred in July, was the Edinburgh and Dalkeith.

The space at our disposal herein, when, in our issue of September 25th we gave the sequel to the agitation sixty years ago as to the amalgamation of railways, did not permit the mention of one important result that at once followed the report of the 1872 Select Committee on Railway Amalgamations and Agreements. Paragraph 21 of the Committee's report recommended that "to perform the various duties referred to in this report, a special body should be constituted, entitled the Railway and Canal Commission," which shall consist of not less than three members. They should be persons of high standing, of whom one should be an eminent lawyer and one should be acquainted with the details and practice of railway management." Recommendation 22 advised that all questions for arbitration should be referred to the new body. The Railway and Canal Traffic Act, 1873—36 & 37 Vic., c. 48—followed. Under it "not more than three Commissioners" and "not more than two Assistant Commissioners" were to be appointed "for the purpose of carrying into effect the Railway and Canal Traffic Act, 1854." One of the three Commissioners was Mr. W. P. Price, who had been the chairman of the Midland Railway, and fully met the condition as to being acquainted with the details and practice of railway management. The two Assistant Commissioners were not appointed. Under the Railway and Canal Traffic Act, 1888—51 & 52 Vic., c. 25—the legal side of the Commission was strengthened, for, in addition to two Commissioners—one of whom was to be of experience in railway business—there were to be three *ex-officio* Commissioners, one for England, one for Scotland, and one for Ireland, all of whom were to be judges of a superior court.

Notes and Memoranda.

Engineers associated with the television broadcasting station of the Columbia chain contend that there is no question that interest in television is growing rapidly, and that sets are being installed in homes at an increasing rate. They hold that it is not at all far-fetched to believe a million sets will be in active use before the end of 1933, and possibly more than 11,000,000 television receivers will be in domestic use by 1942. It is estimated that there are now about 30,000 sets in use throughout the country.

A car-parking scheme, devised by a consulting engineer of the Westinghouse Electric Company, East Pittsburg, presents novel features. The scheme provides for vertical parking by means of cradles, one for each car, supported between two endless chains, which pass over sprocket wheels at the top and the bottom of the building. The chains are driven by two electric motors, and, by means of a push-button control or its equivalent, any cradle can be brought quickly to the level for receiving or discharging a car.

It is generally considered that no special protection against lightning is necessary in the case of underground electric cables. In a recent issue of *Elektrotechnik und Maschinenbau*, however, reference is made to the damage by lightning of the underground telephone cable connecting Switzerland and Austria, and to a cable between Salzburg and Reichenhall. The damage to the cables was of two kinds, resulting either from a discharge between the core of the cable and its sheathing, or the fusion of the cores as a result of the high current density induced in the cable. In the article Herr M. K. Beiling considers that cables can be protected by laying in the trench about 8in. above them a stranded iron-wire cable, such a protective lightning conductor having been adopted with good results in connection with the telephone cable of the meteorological station on the summit of the Zug mountain.

Although considerable improvements have recently been made in chromium plating, especially in the direction of obtaining thicker layers—up to 0·007in. thick—with corresponding increased resistance to corrosion, it yet remains true, states the *Chemical Trade Journal and Chemical Engineer*, that tungsten plating is in many ways superior and more resistant. For example, a metal electroplated with tungsten is not affected by any mineral acids, and although it is attacked by a mixture of nitric and hydrochloric acid, it is resistant to either separately. It is thus very valuable in chemical plant. Also its silvery white colour, and the fact that it does not tarnish in dry air, is unaffected by sulphur and phosphorus, and is exceedingly hard, make it very attractive for many uses in the electrical and allied trades. Its high thermal conductivity and melting point make it particularly suitable for electrical contacts and arcing points exposed to great temperature changes.

Aerial cableways for the transportation of sightseers to the tops of mountains have been developed to a high degree in Germany. The usual cableway consists of two cars that balance each other, each supported by a carrying rope and connected to a continuous-traction cable driven from the upper terminal. There is a tendency to use higher tension in the cables to obviate the effect of sag, which causes undue wear at the support. Extremely long spans are common, the cableway at Table Mountain, South Africa, extending 3937ft. without intermediate support. The use of light metals for car construction has effected a reduction in the average weight of these units to 90 lb. per passenger. Customary speeds are from 980ft. to 1000ft. per minute. Provisions for safety are very rigid, including daily inspection of the cables, an automatic clamp that locks the car to the carrier cable in case of breakage in the traction cable, and a car control that makes it possible to stop at any point without the necessity of notifying the motor operator.

Several points of interest are to be noted in connection with the equipment of the new station at Johannesburg, now nearing completion. All the offices and corridors are to be lighted through diffused glass fittings, and floodlights operated from the top of the building light up the baggage quadrangles. For the concourse, dining and waiting rooms, and refreshment rooms, specially designed fittings will be used which harmonise with the general architectural effect, the lights in the concourse being operated automatically by time switches. A sub-station will supply power to all the station lifts, of which there will be three for passengers, five for baggage and parcels, two for books, and one for bullion. All the lifts will be provided with both pilot and push-button control systems. All cooking appliances in the kitchen and elsewhere will be electrically operated, including the tea and coffee urns, cocktail shakers and refrigerators. The station will be equipped with eighty clocks, all controlled by electricity from a master clock. The hot water for heating the building will be circulated by electrically driven pumps, and the machines of the ticket-printing department in the basement will also be electrically driven.

The concluding examination of the factors that make it possible for a lead blast-furnace handling a rich charge to make as much as 200 tons in one day is given in Report of Investigations 3096 of the United States Bureau of Mines, issued recently. This paper considers the conditions at the tuyere zone of such a furnace. When the maximum capacity was obtained, the active free area at the tuyere zone was found to be only about 25 per cent. of the total. The gases in this zone were, however, extremely hot, and the concentration of carbon nonoxide was high. Moreover, this zone was at the apex of a funnel-shaped mass of semi-molten charge that extended upward, thus giving considerable surface. Coke was found to arrive irregularly at the tuyere zone, and this gave a very unexpected condition of alternate reduction and oxidation. Such a condition made it possible to oxidise some of the sulphides ariving at the tuyere zone, among which was lead sulphide, unaltered in the fusible rich charge. At other times the atmosphere was very highly reducing, which, together with the high temperature, made it possible to metalise and liquate out the lead at a rapid rate. The blast-furnace with a short column and a small amount of coke and a rich charge then operates in many ways similarly to a Scotch hearth.

Miscellanea.

The submarine "Nautilus" is to end her career at the bottom of the sea, for the United States Shipping Board has given Sir Hubert Wilkins permission to sink her. Her resting-place will be by the coast of Norway, where the North Sea is at its deepest.

The establishment by private enterprise of a highly developed modern system of trunk line motor roads, joining the more important cities of Italy, the ownership of which after fifty years will revert to the State without further compensation, is planned among other projects now being considered by the Italian authorities.

It is reported from Rio de Janeiro that engineers belonging to the Ford Company have recently discovered a process for the reduction of Brazilian iron ore in which any quality of coal can be employed, even the poor lignite found in immeasurable quantities in the States of Rio Grande-do-Sul, Santa Catharina and Paraná.

Some idea of the cost of electrification in the county of Yorkshire was given by Mr. Alan Thwaites, when he lectured recently before the Electrical Association for Women. He estimated that to deal with an area 10 miles square, containing a possible five thousand homes, would involve a capital expenditure of something like £60,000.

Part of the success of the rural electrification work of the Bedford Corporation, states *Rural Electrification and Electro-farming*, is no doubt due to the fact that hire and hire purchase terms are available for many domestic appliances. Electric lawn mowers can be purchased over a period of three years, and deferred terms are also available for the majority of agricultural appliances, such as milking plants, portable motors, incubators, &c.

The Council of the Institution of Engineers and Shipbuilders in Scotland, in its anxiety to ease the burdens of members in the present financial situation, has decided to grant a rebate to those members who are content to receive the monthly parts of the "Transactions" and to forgo the bound volume. The rebate which will be allowed to members, associates and associate members of more than three years' standing is 7s. 6d., and for associate members of less than three years' standing 5s.

Meetings are taking place at industrial centres throughout the Soviet Union in connection with the one hundredth anniversary of Faraday's discovery of the law of electro-magnetic induction. Special attention is being paid to the application of Faraday's discovery to modern electrical engineering, and in particular to the development of the electrification of the Soviet Union. A committee has been established in Moscow for this purpose under the chairmanship of Krjijanovski.

The manufacture of zinc oxide, which was carried on for a number of years at Callington, East Cornwall, until lack of materials during the war led to its discontinuance, has now been revived. Already this development has absorbed some of the unemployed in the district, and it is anticipated that work will be found for a still larger total. The prospects of the re-established industry are said to be excellent, the whole of the estimated output for the coming twelve months having been disposed of.

In a written answer to a Parliamentary question, the Minister of Overseas Trade, Sir Hilton Young, stated on Monday, September 28th, that the applications for space in the London section of the British Industries Fair, 1932, were already:—Olympia, 728 exhibitors for 241,639 square feet; White City, 110 exhibitors for 64,300 square feet; Total, 838 exhibitors for 305,939 square feet. At the corresponding date last year the applications for space were 917 exhibitors for 269,300 square feet.

During the past session the work of the Department of Cold Working of Steel of the University of Sheffield has been carried on by the Ironmongers' Company Research Fellow and the Ironmongers' Company Research Scholars in the laboratories of metallurgy and of engineering. The reappointment of Mr. F. S. Merrils as Research Fellow and of Messrs. J. Dick and R. W. France as Research Scholars for another year is recommended. Mr. R. Goodacre, a University Scholar, has been engaged on work of the same kind, and during the next session two University Scholarship holders, Mr. J. D. Urquhart and Mr. J. W. Rodgers, will be similarly available. Three programmes of research have dealt with the drawing of wire suitable for ropes and springs, the rolling of strip suitable for pressing, and the bright drawing of mild steel bars.

A report from Riga states that the Supreme Economic Council of the Central Trade Union Council have published a joint decree initiating a new system of graduated wages and bonuses for the whole of the coal and metal industries. Ninety per cent. of all underground miners and 70 per cent. of metal workers are to be transferred to progressive piecework payment, with the removal of the limits hitherto restricting the amount of earnings. Diligent workers will receive much more and idlers much less than hitherto. The Supreme Economic Council states that chaotic organisation of labour, bad technical leadership, and a routine system of wages are chiefly responsible for retarding coal and iron production. The remuneration of engineers and technical staff has also been put on a progressive scale, according to the extent of fulfilment of the plans of their particular sections.

A national conference on works management is to be held at the Hotel Rubens, London, S.W. 1, on Friday, October 2nd. Officials responsible for production in many leading companies will discuss greater industrial productive efficiency, which is one of the vital factors in restoring Britain's trade. The principal speakers will be Mr. Frank Hodges, member of the Central Electricity Board and director of Securities' Management Trust, Ltd.; Mr. G. E. Rowland, chairman, Agricultural and General Engineers, Ltd.; Mr. E. J. Fox, managing director, Stanton Ironworks Company, Ltd.; Mr. Robert R. Hyde, director, Industrial Welfare Society; Mr. G. Hurford, director of manufacture, Standard Telephones and Cables, Ltd.; and Mr. A. P. Young, manager, Rugby Works, British Thomson-Houston Company, Ltd. The conference is organised by the British Works Management Association, 68, Victoria-street, S.W. 1.

OLYMPIA EXHIBITION—SOME HIGH-SPEED COMPRESSION-IGNITION HEAVY-OIL ENGINES

(For description see page 341)

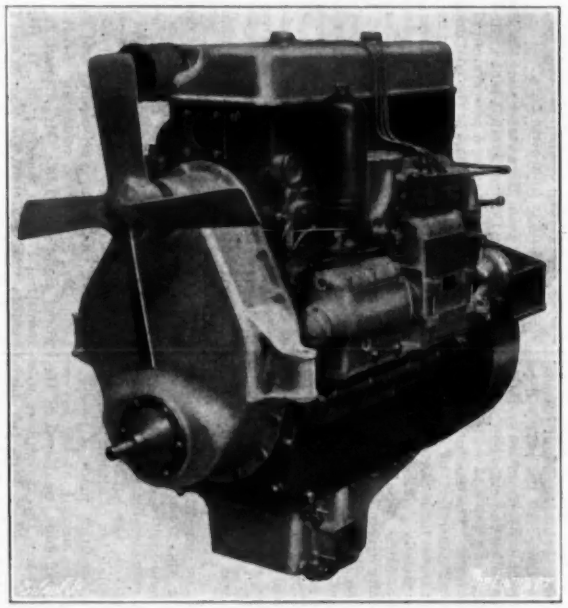


FIG. 108—50 B.H.P. "INVICTA" OIL ENGINE—AVELING

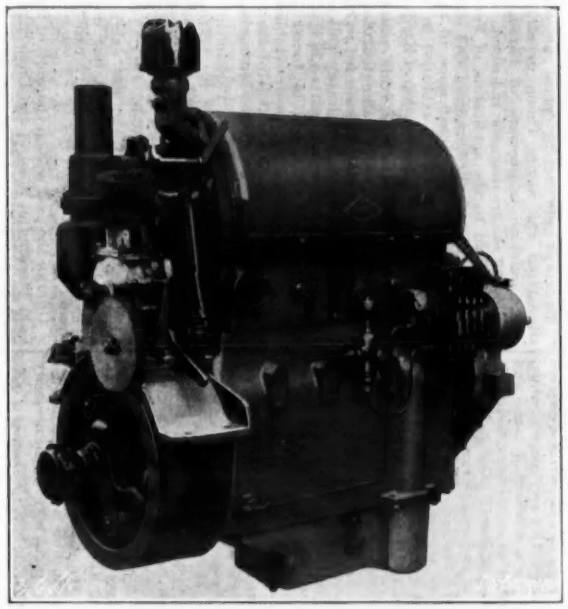


FIG. 109—36-40 B.H.P. "SPRING INJECTION" ENGINE—BLACKSTONE

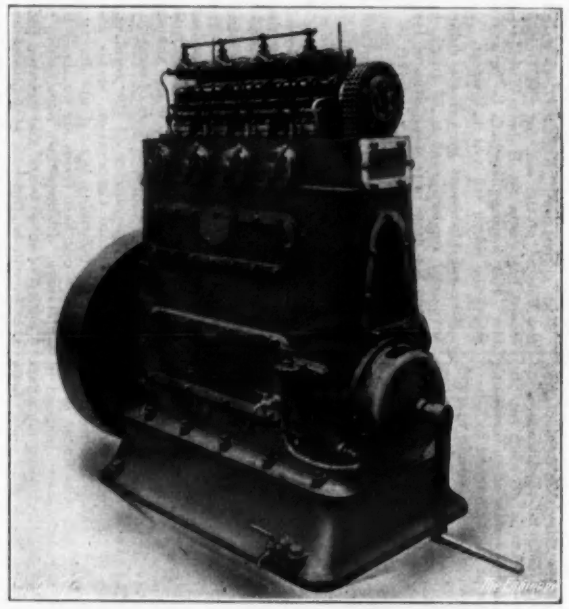


FIG. 110—38 B.H.P. HEAVY-OIL ENGINE—ASTER

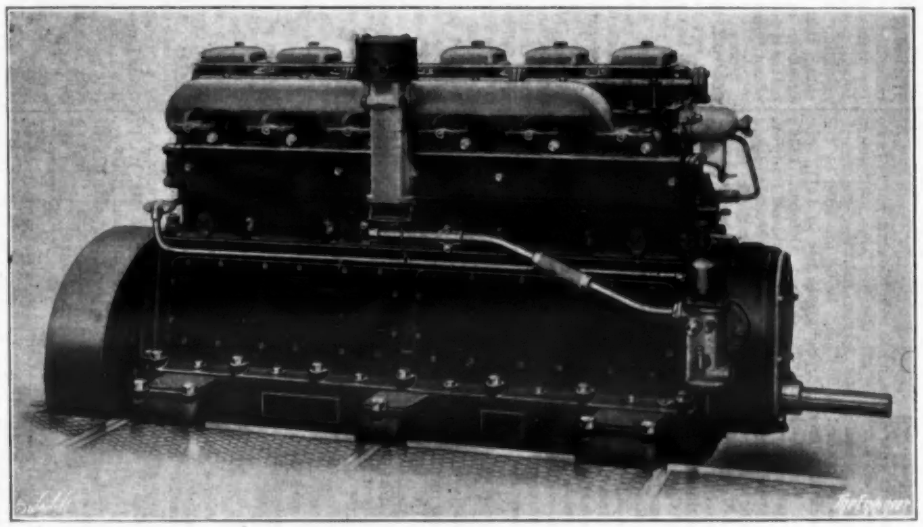


FIG. 111—57 B.H.P. SIX-CYLINDER AIRLESS-INJECTION OIL ENGINE—GARDNERS

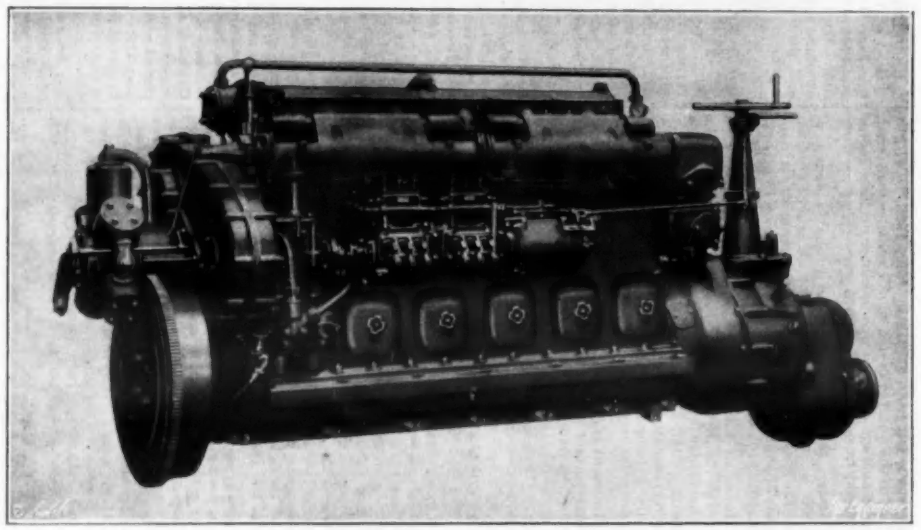


FIG. 112—90-120 B.H.P. SIX-CYLINDER OIL ENGINE WITH REVERSE GEAR—GLENIFFER

The Engineer

Annual Subscription Rates

(Including postal charges).

Subscriptions will be accepted by the Publisher direct or through a newsagent at the rates and in the currencies stated below :—

BRITISH ISLES	£3	5	0	
CANADA	£3	3	0	Thick Paper edition.
	£2	18	6	Thin Paper edition.
ABROAD	£3	7	6	Thick Paper edition.
(except Canada)	£3	3	0	Thin Paper edition.

AFRICA * £3 7s. 6d. † £3 3s. 0d.	Central News Agency All Branches CAPE TOWN : Wm. Dawson and Sons, Ltd., 29–31, Long-street (Box 489) JOHANNESBURG : C. Juta and Co.
ARGENTINE * £3 7s. 6d. † £3 3s. 0d.	BUENOS AIRES : Mitchell's Book Store, 576, Cangallo
AUSTRALIA * £3 7s. 6d. † £3 3s. 0d.	Gordon and Gotch (Australasia), Ltd. All Branches MELBOURNE : Robertson and Mullens, Elizabeth-street
BELGIUM * Fr. 590 † Fr. 550	BRUXELLES : E. Graddon, 78, Rue du Marché-aux-Herbes BRUXELLES : W. H. Smith and Son, 78–80, Rue du Marché-aux-Herbes
CANADA * $15·25 † $14·25	American News Company, Ltd. All Branches MONTREAL : Gordon and Gotch, Ltd., 334, Notre Dame-street, W. TORONTO : Wm. Dawson and Sons, Ltd., 87, Queen-street East TORONTO : Gordon and Gotch, Ltd., 81, Queen-street West
CEYLON * Rs. 44·5 † Rs. 41·5	COLOMBO : Wijayartna and Co.
CHINA * $37 † $34·5	HONG KONG : Kelly and Walsh, Ltd. SHANGHAI : Kelly and Walsh, Ltd.
EGYPT * £5 7s. 6d. (Pt. 330) † £3 3s. 0d. (Pt. 308)	CAIRO : Express Book and Stationery Store, 9, Chareh Maghrabi
FINLAND * M. 650 † M. 605	HELSINGFORS : Akademiska Bokhandeln, Alexandersgatan, 7
FRANCE * Fr. 418 † Fr. 390	PARIS : Boyveau and Chevillet, Rue de la Banque, 22 PARIS : Librarie Berger-Leverault, 229, Bld. St. Germain PARIS : Brentano's, 37, Av. de l'Opera PARIS : Dunod, 92, Rue Bonaparte PARIS : W. H. Smith and Son, 248, Rue de Rivoli
GERMANY * R. mks. 70·00 † R. mks. 65·00	BERLIN–LICHTERFELDE–WEST : H. Hermanns, Dahlemer Strasse 64 A LEIPZIG : K. W. Hiersemann, Konigstrasse 29
HOLLAND * Fl. 41·00 †Fl. 38·00	ROTTERDAM : Hector's Boekhandel, Noordblaak 59 ROTTERDAM : Techn. Boekhandel, "Plan C," Gelderschestraat 4
INDIA * Rs. 45 † Rs. 42	BOMBAY : Thacker and Co., Ltd. CALCUTTA : Thacker, Spink and Co.
ITALY * Lire 300 † Lire 280	MILAN : Ulrico Hoepli ROME : Maglioni and Strini, 307, Corso ROME : Fratelli Treves, Corso Umberto 1, 174 ROME : Fratelli Bocca TURIN : Rosenberg and Sellier, v. Maria Vittoria 18, and their Branches at Naples and Rome
JAPAN * £3 7s. 6d. † £3 3s. 0d.	Maruzen Co. All Branches
JAMAICA * £3 7s. 6d. † £3 3s. 0d.	KINGSTON : Educational Supply Co.
NEW ZEALAND * £3 7s. 6d. † £3 3s. 0d.	AUCKLAND : Whitcombe and Tombs, Ltd. Gordon and Goteh, Ltd. All Branches NAPIER : J. Wilson Craig and Co.
RUSSIA * £3 7s. 6d. † £3 3s. 0d.	LENINGRAD : Mezhdunarodnaya Kniga, Prospect Volodarsky, 53 A MOSCOW : "Litisdat," Kousnetsky Most, 5-15
STRAITS SETTLEMENTS * $29·25 † $27·25	SINGAPORE : Kelly and Walsh, Ltd.
SWEDEN * Kr. 61·00 † Kr. 57·00	STOCKHOLM : A/B Wennergrens Journalexpedition, Stockholm 1 STOCKHOLM : A/B C. E. Fritzes Kungl., Hofbokhandel, Fredsgatan, 2
SWITZERLAND * Fr. 85·20 † Fr. 79·50	BERNE : Joh. William De Groot, Laupenstr, 5 ZURICH : Rosa Leibowicz, 4, Ankerstr.
UNITED STATES OF AMERICA * $16·40 † $15·25	International News Co., 131, Varick-street, New York, N.Y., and all Branches Entered as second-class matter at the Post Office, New York, N.Y., December 12th, 1896, under the Act of March 3rd, 1879 (Section 397, P.L. & R.)

* *Thick Paper.* † *Thin Paper.*

These rates are liable to alteration if exchange fluctuations require it.

*** READING CASES, *to hold two copies of* THE ENGINEER, *cloth sides and leather backs, can now be supplied at 4s. 9d. each, 5s. 3d. post free.*

"THE METALLURGIST."

This Supplement, which deals with the Science and Practice of Metallurgy, both ferrous and non-ferrous, is published free with the last issue of THE ENGINEER in each calendar month.

ADVERTISEMENTS.

The charge for Classified Advertisements is 1/- per line up to one inch—minimum charge 4/-; those occupying one inch or more at the rate of 12/- per inch. Orders must be accompanied by a remittance. The rates for Displayed Advertisements will be forwarded on application. Classified Advertisements cannot be inserted unless delivered before TWO o'clock on Thursday afternoon (the day before publication).

Letters relating to the Advertisement and the Publishing Department of the Paper are to be addressed to the Publisher, all other letters are to be addressed to the Editor of THE ENGINEER.

THE ENGINEER DIRECTORY.

This Directory, which is published annually in the interests of advertisers in THE ENGINEER, may be obtained free of charge on application to the Publisher.

Postal Address, 28, Essex Street, Strand, London, W.C. 2.
Teleg. Address, "Engineer Newspaper, Estrand, London."
Tel.: Central 6565 (8 Lines).

By arrangement with Reuter's Engineering Service, THE ENGINEER *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

Contents.

THE ENGINEER, October 2nd, 1931. PAGE

A SEVEN-DAY JOURNAL .. 339
PRESS TOOL AND FIXTURE DESIGN. No. VII. (Illus.) .. 340
RAILWAY ORGANISATION IN FRANCE .. 341
THE SHIPPING, ENGINEERING AND MACHINERY EXHIBITION AT OLYMPIA. No. IV. (Illus.) .. 341
IRON AND STEEL INSTITUTE. No. I. .. 346
THE FARADAY EXHIBITION. No. II. (Illus.) .. 348
LETTERS TO THE EDITOR—
The Problem of Waste .. 349
The Grampian Power Scheme .. 350
THE CAIRO INTERNATIONAL RAILWAY CONGRESS .. 350
SECOND EXTRA-HIGH TENSION ALTERNATOR FOR BRIMSDOWN .. 350
WELDED STEEL COLUMNS FOR H.M. "S" CLASS SUBMARINE OIL ENGINES. (Illus.) .. 350
RAILWAY AND ROAD MATTERS .. 351
NOTES AND MEMORANDA .. 351
MISCELLANEA .. 351
LEADING ARTICLES—
Prophecy and Progress .. 353
Two Centenaries .. 353
THE BRITISH ASSOCIATION CENTENARY MEETING. No. II. .. 354
SIXTY YEARS AGO .. 355
BOOKS RECEIVED .. 355
POWER .. 356
THE INSTITUTE OF METALS. No. III. .. 358
A PETROL ENGINE DRIVEN RAIL COACH. No. II. (Illus.) .. 359
PROVINCIAL LETTERS—
The Midlands and Staffordshire .. 361
Lancashire .. 362
Sheffield .. 362
North of England .. 362
Scotland .. 363
Wales and Adjoining Counties .. 363
PERSONAL AND BUSINESS ANNOUNCEMENTS .. 363
CATALOGUES .. 363
CURRENT PRICES FOR METALS AND FUELS .. 364
FRENCH ENGINEERING NOTES .. 365
BRITISH PATENT SPECIFICATIONS. (Illus.) .. 365
FORTHCOMING ENGAGEMENTS .. 366

NOTICES TO READERS.

*** *If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

*** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

THE ENGINEER.

VOL. CLII. No. 3951

OCTOBER 2, 1931.

Prophecy and Progress.

THE rapid development of science and its applications during the latter part of the last century gave rise to a crop of prophecies as to the future of civilisation. Such forecasts were mostly concerned with the social and economic conditions of the future, but all had their basis in the trend of technical progress as it appeared to the seers. By assuming the existence of all such inventions as might be required for the purpose, it was easy to show that we were moving towards any particular kind of Utopia that might be selected. Engineers and other responsible men of science refrained, as a rule, from anything like prophecy, even in the matters they were most competent to discuss. There was, however, one notable exception, famous on account of the standing of the man who made it, and striking by reason of the importance and the definiteness of the forecast. Sir Frederic Bramwell was no mere scientific amateur, but a very distinguished engineer, recognised by his contemporaries as possessing perhaps the most commanding intellect in the profession. Addressing the British Association in 1881, he prophesied that in fifty years' time the steam engine would only be spoken of as "a curiosity to be found in a museum," as the gas engine was destined to become the prime mover of the future. So great was the authority of Bramwell that it was as if an oracle had spoken. The boldness of the utterance may be judged by the fact that at that time the gas engine, in anything like the form we know it to-day, was but four years old, and steam held an unrivalled position in the field of power production. Moreover, the only available fuel for a gas engine was town's gas, for the Dowson producer was in its birth throes and several years had to elapse before Thwaites developed the idea of using blast-furnace gas in the cylinder of an engine. Bramwell never renounced his conviction, and shortly before the end of his life in 1903 he made provision for a lecture to be delivered before the British Association in the year when his prophecy was due for fulfilment, the text of the lecture to be his utterance fifty years before.

The date has come and the lecture has been delivered by Sir Alfred Ewing, the one man whom Bramwell himself could have chosen as best qualified to deal with the subject of prime movers. It is a delightful review, with all Sir Alfred's charm of style, but how different is the story from that anticipated by the prophet! He had failed to interpret the writing on the wall, the "Mene, Mene," which should have been clear to so acute a mind long before the date of his unique bequest. For by that time, not only had the limitations of the gas engine become apparent, but the steam engine had already discarded all those features which condemned its rival to its undoing, and, thanks to the genius of Sir Charles Parsons, had become a simple rotary machine with possibilities in respect of power and efficiency undreamt of till then. Three years had indeed elapsed since the two 1000-kW turbines supplied to the city of Elberfeld had opened the eyes of engineers to what steam could do when freed from the constraints of reciprocating motion, and we were within a decade of the still more famous Parsons turbine of 25,000 kW, constructed for Chicago. The overwhelming pre-eminence of steam-driven prime movers over all kinds of internal combustion engines in the field of commercial power production at the present time is abundantly shown in Sir Alfred Ewing's address, which we reprint practically in full on another page. We need not, therefore, enlarge on the subject, nor, with Bramwell's failure in mind, shall we dare to prophesy. But since steam engineers are prepared to guarantee to-day that they will reproduce over 32 per cent. of the heat in fuel, in the form of electrical energy, there appears no threat to the enduring supremacy of steam. It is, of course, possible, though at present it seems improbable for both theoretical and practical reasons, that the gas turbine may have to be reckoned with in the future. The chance may be remote, but unlikely things do happen, and in such an event, when the British Association meets in 1981, steam machinery may be the subject of that antiquarian curiosity which Bramwell foretold for the present year. If so, we shall rejoice in his retarded triumph, for his prediction has at least furnished the theme for a very excellent address.

In the final paragraphs of this address, Sir Alfred strikes a serious, but hopeful note, appropriate to the present condition of our national industries. He does not prophesy, but he points the way to better things. A superficial acquaintance with the theory of Evolution has led masses of the people to believe that progress must inevitably be onward and upward, in obedience to some hidden principle. In human and national affairs there was never a greater fallacy. The only law is one of change, and whether this be for the better or worse, according to our standards, is a matter largely within our own control. *Facilis est descensus Averni*, and every firm, industry, and nation will gravitate surely down the slope failing a sustained effort to improve its position. The British engineering industry has great traditions, but it cannot live on them. We gave the world the steam engine, the turbine, the locomotive, and innumerable other inventions, and while doing so we prospered and were well. We were ascending a path with no resting places and no summit. In recent years our course has been slower and marked with pauses, after which we have too often tried to regain a better position by paying tribute to other nations for work which we should have done as well or better ourselves. The money sent abroad by the engineering industry in payment for designs of internal combustion engines, steam turbines, and even steam engines and condensers, must amount to a most formidable total abstracted from our own industry for the benefit of our foreign rivals. For the greater part of it nothing of any value remains but a bitter experience. If a tithe of the amount spent on financing the research departments of our competitors had been devoted to the development of ideas and designs of our own, many firms would to-day be receiving tribute instead of paying it, besides enjoying the material advantage of the prestige due to leaders. Sir Alfred Ewing, himself a great teacher of youth, stated his conviction that the engineers of to-day had as much courage and enterprise as their forefathers. We believe this to be true, but the time has come to show it by removing from the industry a reproach which its founders would never have tolerated.

Two Centenaries.

CENTENARIES are lofty milestones upon which we mount to look back upon the way we have come and forward to the way we must go. We try to see whither the long road is leading us. We say, "This danger we will avoid," "This pleasure we

will enjoy," "We shall not hurry upon this stage." But the highway winds on, and as we come to each turning we find that, after all, we are following it willy-nilly, and that it is having its way with us; not we with it. We have been standing upon two such milestones for the past ten days—the Centenaries of Michael Faraday and of the British Association, and the old course has been pursued. Speakers have re-told with pride the story of the advance of science and crafts, and in the same breath have warned us against the perils of the road upon which we have set our feet. We have perpetrated a paradox. Whilst we have praised the famous men who laid the stones upon which progress has been built, we have condemned the outcome of their labours! Faraday has been honoured for the gift of electricity in the service of man, and in the same room, even by the same speaker, the value of that gift has been questioned.

It is probable that man has always resisted progress, even whilst he was enjoying the fruits of it. No doubt the craftsmen who chipped flints had ugly looks for the first metallurgists who cast bronze, and the latter, in their turn, used the resources of an improved language to say what they thought about new-fangled iron. The rolling mill and the steam hammer were hated by the men who worked with the sledge and the tilt, and the miller shook his head and his fist when steam took the wind out of his sails. The later history is well known. The coming of machinery was hateful, not only to the craftsmen, but to many others, and the voices of men who proclaimed its evil effects upon their fellows were never wanting. Yet the tide of progress has never ceased; not one of the Canutes, from Samuel Butler to the later prophets, has been able to stay it by an inch. It flows on now just as surely as it has always flowed, and as it will go on flowing, despite the protests of artists, bishops, novelists, and the man-in-the-train. The evils that famous men do live after them. Watt, Faraday, Daimler, Edison, and a whole host of others, must bear the blame of the defects of "progress," and at their centenaries, if we were wholly honest or wholly sure about our distaste for all that has ensued from their works, we should, instead of blowing trumpets, burn their effigies and cast their machines over mountain sides. We do not do so because, as a matter of fact, each one of us enjoys for himself the things which progress has given us; our concern is always vicarious. It is the danger to *others* that we are upset about, or we are offended by the disturbance which they cause us by their enjoyment of the amenities. It is true that much that was good has been spoilt by progress, but much that is better has been given us. Ask any one of those who revile the present age to what period of the world's history they would return, and he does not know. Ask any one of them what single thing he would give up, and he cannot tell you. There is no denying that the advances of applied science are doing some harm; they are wiping away many pleasant things and making vulgar things that were once rare. They have the defects of their merits. Men and women are not quite what they were in the past when they had to rely more upon their own labour. "Machinery," said Mr. Highfield in the address with which he opened the Faraday Centenary meeting last week, "eliminates skilled hand work, probably the most beneficial labour for man." It has, too, weakened men's self-reliance. "Men used to work with every modern labour-saving device are not likely to prove able to develop the outposts of the Empire." It, and other gifts of science, have led to domestic unrest, and the philosophy which springs from science has stolen away many of the ideals which gave strength and purpose to man. All these defects are admitted. Yet, when we survey all the good that has been done—the removal of the causes of epidemics, the gift of light in darkness, the supply of pure water, the ease of national and international communication, the reduction of excessive labour, and the general increase of hours of leisure, with the means for their enjoyment—we must admit that, on the whole, the scientist and the technologist have given the world more than they have taken from it.

If we cannot stop progress, we must make the best of it. That is literally the problem with which every advanced nation is faced. It is unthinkable that we can, or would, ever give up the blessings which we owe to applied science. The world could no longer exist without them. But we must see that they are wisely used. Let us remember that they have come upon us very suddenly, and that, in consequence, we have not been quite able to orientate ourselves to the new conditions. That is the cause of some of the complaints. In time, unless Progress still outruns man's ability to control it, the world will devise means of making it tolerable. The obvious defects which accompany so much of it will disappear. Smokiness is departing, noisiness will follow it, and we may even anticipate that the "wiryness" which is the outward symbol of electric distribution will also go. Even the problem of excess production may in time be solved, and means will be found for consuming harvests which are now too great, and manufactured products which are now too numerous. These things may be left to the economists, whilst the engineer devotes himself to the duty which lies before him—that of removing all that is objectionable from his works and leaving only that which is good and pleasant.

The British Association Centenary Meeting.

No. II.*

SECTION F.

The Department of Industrial Co-operation of Section F (Economic Science and Statistics) arranged a very complete programme of discussions relating to industry. The first took place on Thursday, September 24th, when the subject of "The Aims, Methods and Progress of Research into Management Problems" was dealt with. Mr. B. S. Rowntree was in the chair.

Major L. Urwick, Director of the International Management Institute, Geneva, opened the discussion by dealing with the international position. He said that one of the chief results which might be anticipated from a more scientific examination of business management was a growing recognition of the essential unity of management processes whatever the purpose to which they were applied. Two principal difficulties, however, were retarding development. In the first place, the very volume of work that was being done and published made it difficult for the average manager to keep pace with new developments, despite the increased specialisation of function which characterises industrial organisation. Yet there were hundreds of factories in half-a-dozen countries attempting solutions of similar problems, but when there were at least 20,000 volumes in the management field, and when one country alone published over 100 periodicals a month devoted to management questions, how could the busy manager hope to keep pace with his job. A partial solution had been found in the publication by management institutions in different countries of digests of the literature. The same function was carried out internationally by the International Management Institute at Geneva. There was, however, no such institution in Great Britain. At the same time, even where such institutions existed, the problem was a serious one. The second difficulty was more serious. However scientific the management in a given factory might be, the solutions of particular problems remained isolated. The test of effectiveness was limited to the broad issue of whether one enterprise made a profit as against another, and it did not provide a method of measurement which threw any light on the details of comparative performance. Management research, therefore, fell into three main lines of development. There was what was called laboratory research, directed either towards extension of one of the sciences underlying management or towards their application to a specific management problem. Secondly, there was research within the factory carried on by the managing staff in the search for higher efficiency through scientific method; and thirdly, there was research outside the factory through the appropriate professional institution. All that, however, related to individual enterprise in single factories, but practically nothing was known of the principles which should govern the administration of large-scale combinations of previously independent units, so increasingly characteristic of modern business. Was it too much to hope that as far as Great Britain was concerned the initiative taken by the British Association this year might develop into that integration of science and industry which alone could secure a new approach to the whole situation? Were it possible to agree as between the nations that the purpose of all economy was a higher standard of life for the world community, there was no inherent impossibility in applying the conceptions and technique of management to every aspect and level of economic activity. Until it was done, until modern business was conducted in conformity with the principles which created it, the present confusion would not only continue, but would grow inevitably worse.

Sir Horace Wilson, Chief Industrial Adviser to the British Government, referring to the British position, said that although the support that had hitherto been given to the Management Research Groups in this country by those concerned in industry was less than might have been expected, and was a good deal less than the needs of industry demanded, considerable attention was being given to management problems here. The Management Research Groups offered a means of developing the habit of interchanging knowledge and experience, a habit which seemed to grow somewhat slowly. Many observers thought that the weak part of the British industrial structure lay not so much in its plant or technical efficiency as in its organisation, but there was room for difference of opinion as to what types of organisation were best suited to British conditions. It was from the study of the problems of management by those actively engaged in the day-to-day work of administrating large business concerns that help must be sought, not only in discovering the principles that should be observed in organising the large units that appeared inevitable, but in providing the men capable of managing them as and when they were formed.

The American and the Austrian positions were also discussed, the former by Dr. H. S. Person, managing director of the Taylor Society of New York; and the latter by Dr. Hellmuth Boller, of Vienna.

A contribution of considerable interest was presented on Monday, September 28th, entitled "Bridging the Gap Between the Birth of an Idea and its Industrial Application," by Mr. A. P. M. Fleming, C.B.E., manager of the research and education department of the Metropolitan-Vickers Electrical Company, Ltd.

Mr. Fleming said that that matter could be considered from two points of view, that of individual firms in individual industries, and that of the nation; but he considered it primarily from a national point of view, since the influx of new ideas, such as, for instance, a new scientific discovery or a new method of adapting an already established scientific law, might have application in a great variety of entirely different industrial processes in many different industries. The natural tendency in improving processes in established industries was to reduce, rather than to increase, the skill of the worker as well as to reduce employment. To increase employment, whether for the world in general or for our country in particular, it was necessary to give attention to every means whereby new ideas and new knowledge could be translated into new industrial activity and to expedite the various stages by which that could be accomplished. Every new industry or industrial activity originated in the mind of some one, and its conversion into manufacturing activity involved, in general, a certain sequence of operations. If the idea was fundamentally new, there was, first, need for some fundamental research. If that initial fundamental research was successful, the next stage was to conduct such industrial research as would test the possibilities of practical industrial application and the economic value of the idea in comparison with any competitive production which it was designed to replace. The third stage was that of semi-scale manufacture which would enable all manufacturing difficulties likely to be encountered in full-scale manufacture to be overcome.

The next stage was the selection and training of workers to undertake the commercial production and, contemporary with that, the problem of finance required to establish production and marketing facilities. The last stage was the design and installation of the requisite productive facilities and the building up of the manufacturing organisation.

Existing conditions suggested the need for some organisation which could carry through the whole sequence of operations indicated. The type of organisation required already existed in the form of a few private industrial research organisations, which were able to carry through the whole sequence of operations necessary, but they naturally undertook only developments which appeared to offer attractions in the particular sphere of manufacture in which their concerns were interested. A national organisation could embark upon a much wider programme of developments, including not merely those which from the outset offered attractions of considerable financial return, but those developments which might yield only such return as would, in a national sense, balance the cost of unemployment and thereby help to retain the asset of the workers' ability, which in the case of the unemployed depreciated at a very rapid rate. He was therefore of the opinion that a new organisation was necessary if those benefits were to be secured in their fullest national sense, an organisation which comprised research facilities of an industrial character, a scientific staff of considerable and varied industrial experience, means for dealing with the semi-industrial scale of production, and financial means for proceeding through the first few years of development until the commercial value of the new product could be definitely assured, to a point at which the necessary finance for the exploitation on a commercial scale could be attracted. Such an organisation would require to be operated with complete freedom from Government control and with the same mobility and type of administration that is found in the limited liability company.

SECTION G.

Metals and Alloys.

Following the reading of Sir Robert Hadfield's paper on "Faraday's Steels and Alloys," reported in The Engineer last week, the Chairman, Sir Alfred Ewing, called upon Dr. Walter Rosenhain to present

* No. I. appeared September 25th.

his paper on "Metals and Alloys in relation to Engineering Progress."

In this paper Dr. Rosenhain said that engineering progress was dependent upon the collaboration of the engineer and the metallurgist. As a result of the rapid development of aircraft and of high-speed transport on sea and land, metals having a high ratio of strength to weight had become very important. The resistance to corrosion of such metals was sometimes a major consideration. The rust-resisting steels offered great advantages from that point of view, and it was now believed that metal as rust-resisting as the 8/18 nickel-chromium steels, which had superior mechanical properties, particularly in regard to elastic limit, yield stress, and fatigue range, might be developed. Beryllium afforded potentialities, not only as an alloying element, but as a basis metal. There was a second group of materials which had already attained importance—those for use at high temperatures. In cases where such metals were needed, it was necessary to combine high resistance to gradual deformation or creep at high temperatures, with chemical resistance to the actions of steam, flue-gases, coal hydrogen mixtures and other agents. In many cases failure at high temperature occurred by separation of the crystals from one another, so that strengthening the crystals themselves was insufficient. The great problem which confronted those working in that sphere was the finding of means to increase the inter-crystalline cohesion at high temperatures. The improvement of materials in regard to resistance to wear or abrasion was essential to engineering progress. So far, many requirements had been met by the production of specially resistant types of cast iron, by the nitride hardening of steel and the production of very hard alloys for cutting tools, including those of the stellite type and the newer tungsten carbide materials. With all materials, freedom from accidental defects and variations of properties was likely to prove in the future to be as important as the maximum physical characteristics. The use of X-rays and of magnetic and electrical methods of non-destructive testing was likely to develop still further.

Opening the discussion on this paper, Sir Alfred Ewing spoke of the immense practical consequences of finding steels that would stand up to high temperatures without creep. In steam turbine practice the engineer was strictly limited in development by what the metallurgist could give him in metals.

Sir Robert Hadfield asked if there was any possibility of obtaining higher limits of tenacity than were available to-day, without the introduction of brittleness. Were that a possibility it would be of immense value to engineers.

Dr. C. H. Lander called attention to the urgent need of obtaining cheap metals of the cast iron type to stand temperatures of 600 deg. to 625 deg. Cent. It was imperative to obtain something that would preserve its form under such conditions to a much greater extent than the materials now available. If such a slight improvement was possible that the temperature at which early deformation took place could be raised 50 deg. Cent. from the present standard, certain processes would become immediately of practical value. The Gas Light and Coke Company had undertaken a joint full-scale test of low-temperature carbonisation with the British Government. One reason for the disbandment of the co-operation was the lack of a metal with the desired properties. Some of the retorts became useless in three months' time; most were useless after twelve months. With the assistance of the Cast Iron Research Association the maximum life attained was only two years. If some fraction of the present efforts could be applied to that specific problem, great benefits might accrue, but finance was a difficulty.

Mr. J. S. Wilson asked if there was any possibility of obtaining a metal with a higher modulus of elasticity than that of steel or iron. He thought such a material would prove of great service as a reinforcement for concrete.

Professor Fulton and Professor F. C. Lea both called attention to the subject of creep, particularly in regard to the effect of a repetition stress at high temperature superimposed upon an initial stressing.

Dr. W. Rosenhain, in reply, said that the tensile strength of iron in service was still far short of the cohesive strength of the material. The cohesive strength of some materials had been developed, but were that the case with iron it was unlikely that engineers would use it, because it probably would be in an unstable condition. The difficulty in meeting the conditions referred to by Dr. Lander was that the material must be cheap. The effects of alternating stresses superimposed upon stress under high temperature had been found in many investigations, and as similar results could be, and had been, found in repeated experiments in other laboratories, they could not be gainsaid. It was necessary, however, to have further information before scientists could claim to understand such actions.

Temperature and Metals.

Professor F. C. Lea then presented a paper prepared by himself and Mr. C. F. Parker on "The Effect of Temperature on Some of the Physical Properties of Metals." In it the authors dealt with the phenomenon and methods of measurement of positive creep in relation to temperature and stress, and referred to the secondary effects which were important, especially when metals were subjected to high temperatures for long periods. The problem was complicated by changes in the effective dimensions of the material, which might take place owing to surface corrosion and to inter-crystalline corrosion, both of which diminished the area of any specimens under test. When the material was subjected to repeated stresses, superimposed upon an existing mean stress due to internal or external conditions, such concentrations of stress might lead to fractures of a brittle character, similar to those occurring under fatigue conditions. After describing the apparatus used in creep tests, Professor Lea showed some of the results attained.

Atmospheric Corrosion.

Professor Ernest Wilson then submitted a paper on "The Origin of Iron in Corrosion Products Due to London Atmosphere." Chemical analysis, he said, of the corrosion products on certain aluminium and copper conductors, exposed to the atmosphere on the roof of King's College, London, showed that iron was present in considerable quantities. The experiments detailed were concerned with the origin of that iron, which must have been derived from an outside source. Analysis of the corrosion on a very pure aluminium conductor, which had been exposed for twenty-three years, showed that apart from alumina and metallic aluminium, it contained sulphate in appreciable quantity and a trace of chloride, as well as traces of iron, but no zinc or nickel. In the case of annealed copper, the aqueous solution from the cold powder contained quite an appreciable amount of copper sulphate, but no soluble iron. The residue was partly soluble in hydrochloric acid, giving cuprous and cupric chloride. It also contained carbon and iron in considerable amount. The corrosion products were magnetic. Soot was tested as the possible source of the impurities. It was found to contain an appreciable percentage of ferrous sulphide. The similarity of its magnetic properties with those of the corrosion products suggested that the iron found in the deposits came largely, if not entirely, from the products of combustion during the burning of coal.

Broadcasting.

When Section G resumed on Friday morning, September 25th, with Sir Alfred Ewing in the chair, the first paper was presented by Mr. Noel Ashbridge (Chief Engineer to the British Broadcasting Corporation), who dealt with "The Acoustical Problem of Broadcasting Studios." Economic and practical considerations, he said, frequently prevented the adoption of the ideal specification. The first consideration was to ensure that no spurious sounds reached the studio at an audible level. With buildings erected on the steel frame principle, the ranges of transmission of sound from one part of the building to another were greatly increased. In the new building of the B.B.C. at Langham-place, the studios were contained in the central portion, the walls of which were mainly composed of brick, steel girders being only used on the lower portion, and not in such a way as to cause transmission of sound from one studio to another. When studios were situated in large cities, it was normally necessary to insulate them entirely from the outside atmosphere, in order to exclude traffic and similar noises. That involved the installation of a complete system of air-conditioning plant blowers and ducts. Separate plant had to be used for each studio and all ducts were lined with sound-absorbing materials.

The materials for treatment of the wall surfaces of studios could only be selected by actual tests in a room prepared for the purpose. Such a room had to have absolutely rigid walls, ceiling and floor, and the whole surface should be covered with material which gave almost complete reflection of sound at all audio frequencies. Such results could be obtained with plate glass or glazed tiles, firmly embedded in cement. When it was required to test any wall-covering material, a sample of known area was introduced and the change in reverberation period measured. From those measurements it was possible to calculate the degree of absorption possessed by the material for each frequency considered. It might be thought that if a studio possessed good acoustical properties, the correct position for the microphone could be found by trial at what point in the studio the music was heard at its best. Generally, that would be at a point sufficiently far from the players to produce a kind of focus of the orchestra as a whole. It would be found, however, that at such a position the sound level was insufficient, and with some types of microphone, for instance, those which in themselves produced an unavoidable background noise, the ratio of the wanted sounds to the background noise was often too small. Two or more microphones working simultaneously were sometimes used to get over difficulties with large orchestras.

Professor G. W. Osborne Howe, opening the discussion, said no branch of science had made such rapid progress in the last few years as acoustics. Enlightenment was gradually spreading to architects on that subject as on illumination.

Professor W. Cramp thought that architects generally neglected all acoustical principles in their designs of buildings. The effect of the B.B.C. effort might lead to the recognition of the necessity for good acoustical properties in all public buildings.

Mr. E. R. Relf called attention to the fact that the conditions in a concert hall were entirely dissimilar from those in a listener's home. The players could be seen in the hall and their parts in the orchestral work appreciated by their coming from a definite location. In the loud speaker all were blended together and one could not tell where the individual instruments were situated.

Gliding.

Colonel The Master of Sempill then presented a paper on "Motorless Flight." Gliding in Great Britain was, he said, advanced partly for scientific and technical reasons, but mainly because of its sporting possibilities. It was essential that greater attention should be given to the scientific aspects, both in regard to aeronautics and to meteorology. The glider was a robust, simple machine, with no attempt at refinement and not intended for anything but straight flight, from the tops of hills of moderate height. Sailplaning or soaring was the real objective. Actually the sailplane was a highly developed aircraft in the design and construction of which great care was taken to minimise resistance and to achieve the highest efficiency alike as to gliding angle, sinking speed and speed range. The work involved in the design, construction and operation of gliders and sailplanes offered considerable scope for those who desired to obtain first-hand knowledge of aeronautical science and engineering, who were otherwise debarred from obtaining the requisite training. As compared with an aeroplane, the sailplane was a much nearer approach to ideal aerodynamic form, because it was not affected by the difficulties entailed when engines and undercarriages had to be fitted. Meteorological knowledge had been added to appreciably through sailplane flights.

In the discussion, Sir Gilbert Walker dealt with the meteorological aspects of gliding, and said the properties of small clouds were very surprising. Supersaturation within them was from 200 to 300 per cent. It was much easier to make observations at 20 miles per hour than at 80 miles per hour. He welcomed the use of gliders as a means of improving knowledge of meteorology.

(To be continued.)

SIXTY YEARS AGO.

It is quite well known that Sir Henry Bessemer was a prolific inventor in many fields far removed from the production of steel. It is also quite well known that many of his inventions outside the domain of metallurgy were sources of much loss and disappointment to him, and that some of them were quite impracticable. Like many other scientists and engineers of his time, he was keenly interested in the improvement of artillery. In this department of invention his ideas ran riot. At one time he devoted much attention to the production of a steam gun, a gun, that is to say, in which the propulsive energy was derived from steam instead of from gunpowder. The invention was a complete failure, but Bessemer did not for that reason abandon his interest in artillery. In our issue of October 6th, 1871, we illustrated and described his latest contribution to ballistic science. Reverting from steam to gunpowder, he resuscitated the idea of employing more than one charge of propellant and of igniting them in succession. The underlying object was to permit a heavy charge of quick-burning powder to be used without entailing an excessively high initial ignition pressure, and the consequent necessity for a gun of great strength and weight. The system had been proposed before, notably by Lyman in the United States, who employed four or five separate charges inserted in pockets down the length of the barrel. Bessemer proposed to use a species of breech block fitting the bore of the gun in rear of the shot, and containing fifty-five deep small-diameter holes. In each of these holes a charge of powder was to be placed. The charges were to be fired in succession by means of an electrical battery and a string of insulated contacts inside the barrel, the succesive circuits being completed by the shot as it passed down the gun. It was contemplated that the pressure realised would be substantially uniform and would amount to about 3000 lb. per square inch. The gun would be about 24in. in diameter and from 50ft. to 60ft. in length. In our comments on the merits of the invention we were facetious. There were, we pointed out, only fifty-five cells in the breech block, and there were only 110 wires to insert in 110 holes, and to connect with the cartridges. The time required for the purpose would, we remarked, not be worth speaking about. To any contentious individuals who might suggest that the invention involved a maze of wires which would get in everyone's way and prevent more than two shots being fired in an hour, we had nothing to say except that they were opposed to progress and beneath notice.

BOOKS RECEIVED.

Technical Writing. By T. A. Rickard. Third edition. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 10s. net.

The Electric Trolley Bus. By R. A. Bishop. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 12s. 6d. net.

Le Commandement Naval en Mediterranée; Pendant la Guerre de 1914–1918. Paris: Payot, 106, Boulevard St. Germain, France. Price 30f. net.

Wireless: A Treatise on the Theory and Practice of High-frequency Electric Signalling. By L. B. Turner, M.A., M.I.E.E. London: Cambridge University Press, Fetter-lane, E.C. 4. Price 25s. net.

Power.*

By Sir ALFRED EWING, K.C.B., LL.D., D.Sc., F.R.S., President of the Section.

It is perhaps right to warn you at the outset that this is an attempt to kill two birds with one rather large stone. The address has to serve a double purpose. Besides being the usual offering to convention which is expected of the President of a Section, it has the responsibility of being a thesis, delivered in fulfilment of a trust which was undertaken by the British Association many years ago. The thesis has a prescribed theme. So instead of being free, as presidents of sections generally are, to choose any text, or none, I find a text ready chosen for me. It is taken, as you will presently see, from one of the prophets. Not one of the minor prophets, for the prophecy about which I have to speak was uttered by Sir Frederick Bramwell. Nobody who is old enough to recall Bramwell's commanding presence, his generous proportions, his patriarchal air, his pleasant acceptance of acknowledged leadership, will ever think of him in terms such as the word "minor" would imply. Fifty years ago he was Pontifiex Maximus in the world of engineering, not because he built bridges, but because he spoke with almost papal authority. An opinion by Bramwell could do much to make or mar any enterprise. To-day we have to discuss a forecast which he offered at the jubilee meeting of this Association, a forecast to which he and his contemporaries attached particular importance. We must now assign to it a place in the long list of prophecies that have turned out to be over-statements; nevertheless, it deserves attention, not only as an item in the history of mechanical science, but because in the light of present-day experience we recognise how much there was in it of the vision of truth.

A quarter of a century ago I presided over Section G and now the honour is unexpectedly repeated; I am taken off the shelf, dusted and set to function. It would seem that the Council's policy in this happy centenary is to trot out some of the veterans, for the entertainment, let us hope, of less fallible youth. Before asking me to act as President of the Section, they had invited me to give the Bramwell Lecture, and I could accept the two duties only through their kindness in allowing one address to serve for both.

To explain the task of the Bramwell lecturer we must recall the meeting of 1881, when the Association was celebrating its jubilee in the heyday of Victorian prosperity and confidence. It was a jubilant jubilee. Never, perhaps, was applied science more actively progressive. From day to day its achievements compelled attention. Electricity was knocking at the door, bringing a wallet big with gifts, wonderful gifts that established new contacts between the sciences of the laboratory and the arts of social life.

The President of Section G was Sir William—afterwards Lord—Armstrong. His address was mainly on other subjects, but incidentally it contains an exceedingly apt criticism of the steam engine as they knew it then. He said: "In expanding the steam we quickly arrive at a point at which the reduced pressure on the piston is so little in excess of the friction of the machine as to render the steam not worth retaining, and at this point we reject it. In figurative language, we take the cream off the bowl, and throw away the milk." I shall show later that in the modern use of steam we no longer have to cry over the spilling of milk to which Lord Armstrong referred.

After the President had spoken, Bramwell also gave an address "On Some of the Developments of Mechanical Engineering during the Last Half-century," which is printed *in extenso* in the report. It reviews a great field with the lucidity of which he was a master, dealing specially with applications of the steam engine, and it includes a section relating to the transmission of power. Electrical transmission is barely touched on; it had, in fact, scarcely begun; but he speaks of transmission of power by means of gas, and in that connection he remarks:—

> "I think there is a very large future indeed for gas engines. I do not know whether this may be the place wherein to state it, but I believe the way in which we shall utilise our fuel hereafter will, in all probability, not be by way of the steam engine. However much the mechanical section of the British Association may to-day contemplate with regret even the more distant prospect of the steam engine becoming a thing of the past, I very much doubt whether those who meet here fifty years hence will then speak of that motor except in the character of a curiosity to be found in a museum."

The view expressed by Bramwell in this remarkable forecast found support in more than one quarter. In the following year Sir William Siemens, President of this Association, said:—

> "Before many years we shall find in our factories and on board our ships engines with a fuel consumption not exceeding 1 lb. of coal per effective horse-power per hour, in which the gas producer takes the place of the somewhat complex and dangerous steam boiler."

Again, the late Lord Rayleigh, speaking from the presidential chair at the Montreal meeting of 1884, says:—

> "The efficiency of the steam engine is found to be so high that there is no great margin remaining for improvement. The higher initial temperature possible in the gas engine opens out much wider possibilities, and many good judges look forward to a time when the steam engine will have to give way to its younger rival."

Bramwell himself returned to the question when President of the Association in 1888, and in his address from the chair he repeated the forecast of 1881. It is evident that he took his "prophecy" very seriously. He was the acknowledged sage and spokesman of the engineering profession, occupying in that regard a unique position, such as no one could possibly hold in the more complex conditions of to-day. He was a humorist, and doubtless there was a conscious touch of humorous exaggeration in what he said. But for all that, it was an engineering judgment delivered *ex cathedra*, and his judgments were accustomed to command respect.

Finally, in July, 1903, when within a few months of his death at the age of eighty-five, he wrote as follows to the President of this Association. After quoting the words he had used at York twenty-two years before, he proceeded thus:—

> "In saying this, no doubt, I then thought I was speaking somewhat hyperbolically, but from the close attention I have paid to the subject of internal combustion engines, and from the way in which that attention has revealed a continuous and, year by year, a largely increasing development of such engines, I feel assured that although there may still be steam engines remaining in work in 1931, the output of steam engines in that year will be small as compared with the output of internal combustion engines."

He added that he wished to keep alive the interest of the Association on this subject, and for that purpose offered a sum, which was to be invested in Consols, and in 1931 was to be paid as honorarium

> "to a gentleman to be selected by the Council to prepare a paper having my utterances in 1881 as a sort of text, and dealing with the whole question of the prime movers of 1931, and especially with the then relation between steam engines and internal combustion engines."

That is the task I am now attempting to discharge. You do not need to be told that the prediction has, in great measure, failed to come true. Steam is neither dead nor dying. On the contrary, its use has immensely developed both on land and sea. To-day it is a much more efficient medium than it was for the conversion of heat into work, and you find it actuating engines of vastly greater individual and aggregate power than any that were even imagined when Bramwell spoke. But alongside of that we have wonderful achievements on the part of the internal combustion engine which go far to justify the enthusiasm that stirred him fifty years ago.

The gas engine itself did not develop so fast as those who had faith in it might have hoped. Sir Dugald Clerk, whose invention of the two-stroke cycle was followed up by many other important services to internal combustion, and who has become its historian, tells us that even in 1898 the largest gas engines then built indicated 220 horse-power. By that time, however, B. H. Thwaite had demonstrated that the so-called waste gases of the blast-furnace were a suitable fuel, and this led makers, especially on the Continent, to take up the design of large gas engines in forms which for some years had a conspicuous vogue. There were examples in which as much as 2000 horse-power was developed in a single cylinder working on the Clerk cycle, and a four-cylinder engine was built to indicate 8000 horse-power. Such engines were notable for their great bulk and weight. They were also for the most part costly failures. The big cylinders, cylinder heads, and pistons were apt to crack. The difficulty of controlling the temperature of the metal and escaping effects of unequal expansion stopped the construction of gas engines with large cylinders. Moreover, apart from that check, it soon became clear that the chief advance of internal combustion was to take place on different lines, namely, by having oil serve as the internal fuel. Gas still plays a useful part, but quite definitely a minor part. The builders of gas engines have wisely sought security by restricting the dimensions of their cylinders, and confidence in their wares is now restored. Their products have a well-established and considerable market. But nowadays when we would treat of what internal combustion has accomplished, and of its future, we turn not to gas engines, but to engines which use liquid fuel. We think instinctively in terms not of gas, but of oil, using that word to include not only the "heavy" petroleum of the Diesel motor, but the more volatile constituents with a lower flash-point, which in this country go by the name of petrol.

The success of the Otto gas engine led makers to design engines operating in much the same way, but using for fuel a spray of oil instead of gas. Such engines found a place where gas was not available, as in the driving of agricultural machinery. For the most part their fuel was the safe and familiar oil of the paraffin lamp. Like the gas engine, they were heavy and they ran at very moderate speeds, such as 200 revolutions per minute. About 1883 Daimler set himself to produce an engine with much lighter working parts which should run at a far higher speed, five times as fast or more, and should use for fuel an oil so volatile that a carburetter would serve to charge the incoming air with combustible vapour. After successful trials with a bicycle, he applied his motor in 1887 to drive a car on the road. That was the beginning of a new era in locomotion. The world discovered in Daimler's petrol engine an appliance such as it had not possessed before—a light, convenient, inexpensive prime mover, yielding amounts of power which were ample for road vehicles, easy to start and stop and regulate, demanding little attention and no particular skill. Before long it gave the city streets an altered character and country roads an unsuspected value. Man acquired a new mobility which changed his notions of distance and of time. In due course the petrol engine also achieved the conquest of the air. At the end of 1903, only a few days after Bramwell's death, the brothers Wright took their first flight in a motor-driven aeroplane. It is the petrol engine that must bear the responsibility—the grave responsibility—of having made it possible for man to fly.

I have yet to mention another milestone in the history of internal combustion. It was soon recognised that the efficiency of the action depended on the extent to which the combustible mixture in the cylinder was compressed before it was fired. The more compression the greater was the subsequent expansion in the working stroke, and consequently the higher was the efficiency. But a practical limit was set by the danger that the mixture would automatically ignite before the proper time if too much compression were attempted. Users of petrol engines know this danger well. Often they try to diminish it by introducing what are called dopes. It is not in petrol engines, however, but in heavy-oil engines that Rudolph Diesel initiated an epoch-making change about 1895. Instead of compressing a combustible mixture, he compressed the air alone, bringing it to a very high pressure, and thereby making it so hot that when the charge of oil was forcibly injected at the dead-point there was instant ignition. This escaped all risk of pre-ignition and greatly augmented the efficiency of the action, as a thermodynamic consequence of the very high temperature at which the fuel gave up its heat. To force the fuel in, he at first employed an auxiliary supply of still more highly compressed air, but this plan is now less common than the simpler one of using a high-pressure pump, which delivers the oil in a spray of exceedingly fine drops. The essential feature of the engine is that the fuel does not enter the cylinder until the air there is highly compressed and the working stroke is about to begin. It is this feature which has made the Diesel engine the most efficient of all known means of obtaining mechanical work from the combustion of fuel. When I say the most efficient, I am using the word in its thermo-dynamic sense; other fatcors obviously enter when you come to consider questions of mechanical simplicity, of suitability for a particular purpose, or of cost.

We have still to speak of how, for larger uses, the steam engine has held its own during this half-century of change.

Many factors have contributed to prevent Bramwell's prophecy from being fulfilled, but none have been so potent as Parsons' invention and development of the compound steam turbine. That invention was no isolated event—no mere throwing out of a happy thought. It was the life work of a man who, to an extraordinary degree, combined creative imagination with energy and persistence and practical skill. The recent death of Parsons has deprived this Association of a famous past-president and a generous friend. Section G in particular mourns the loss of the most illustrious of modern engineers. It is fitting that we should dwell for a moment on the greatness of Charles Parsons.

The turbine as we know it now is the product of sustained effort and unquenchable faith. The genius of Parsons was indeed of the kind which includes an infinite capacity for taking pains. He was a dreamer of wonderful dreams, but he was tireless in compelling his dreams to come true. He never admitted defeat; a difficulty was a thing to be overcome, an obstacle was merely an incentive. He loved to attempt tasks which most men would pronounce impossible. And he was the severest critic of his own success; he was always striving to better what seemed already very good. These qualities made Parsons, perhaps, the most successful innovator the engineering world has ever known.

It was my privilege to know him from an early stage in his astonishing career. Every opportunity I had of seeing him at close quarters, of observing how he would bend his mind to the problem of the moment, increased my admiration of the inventor and my regard for the man. To the last, there was an endearing quality of his self-effacement, in the modesty with which he wore his world-wide fame, which gave him a peculiar charm once the veil of shyness was drawn aside. Now that he is gone, his friends feel that they are sharers in a personal no less than a national loss.

But such a man lives on in his achievements. To Parsons it was granted as to few men to see the fruit

* British Association, Section G, Engineering. Presidential address, delivered September 25th, 1931.

of his ideas and his labours. Long before he died the world recognised that he had revolutionised steam engineering. He had taught us how to generate power on a scale and with a concentration never before approached. Nothing, in a sense, could be simpler than his steam windmill with its successive rings of vanes, each in turn taking up a small fraction of the whole energy of the blast. To conceive such a device was one thing, to give it being and action was quite another. That meant many subsidiary inventions and years of toil; it meant the removal of mountains of prejudice and difficulty. But the triumph is complete. Engineers, all the world over, are wholeheartedly converted. They build their steam windmills on a colossal scale, crowding 50,000 or 100,000, sometimes even 200,000 kilowatts into a single unit, confident in the knowledge that no more trustworthy and economical prime mover is available for the gigantic stations which play so important a part in modern civilisation as centres for the production and distribution of light and of power.

All these stations have come into existence in the fifty years which have passed since Bramwell made his prophecy, and in them it has most conspicuously failed of fulfilment. Review the great power stations of the world, and you find their method of manufacturing electric energy from heat is almost wholly through the medium of steam. To illustrate how small a place is taken in them by the internal combustion engine let me quote some figures for British power stations. A return published in 1930 by the Electricity Commissioners gives the aggregate capacity of the generative plant of various types as follows :—

	Kilowatts.
Steam turbines	5,531,952
Reciprocating steam engines	138,806
Oil engines	71,331
Gas engines	17,473
Water power plant	42,208

You will see that oil engines and gas engines together make up only 1½ per cent. of the whole. And it is the case that abroad, as well as at home, the steam turbine is dominant. Its dominance is the more appropriate because the turbine was invented in the first instance for the express purpose of driving a dynamo. Parsons realised, in the early 'eighties, that the generating of electricity gave steam a new job to do, a job that needed high-speed rotation, a job for which reciprocating movement was out of place. So he invented the turbine, in which high-speed rotation was a fundamental feature, and he invented also a high-speed dynamo suitable for it to drive, and he patented them both on the same day in April, 1884. The dynamo, he used to say, gave him as much trouble as the turbine. In all the early turbine-driven dynamos it was the armature that was caused to revolve in a gap between the poles of a stationary field-magnet. But, later, when a demand came for much greater power and much higher electric potential the parts were inverted; the field-magnet was caused to revolve, and thereby to generate A.C. of high potential—often many thousand volts—in a surrounding stator which was made up of highly insulated coils.

It is in the great power stations equipped with large turbines and coal-fired boilers, using steam of high pressure and high superheat, that we find, beyond any question, the most economical production of power. The very bigness of the units tends towards efficiency, but that is not all. The turbine, as a thermodynamic machine, has permitted a far closer approach to the ideal cycle of Carnot than was possible in the reciprocating steam engine, which, as Lord Armstrong said, skimmed the cream and threw away the milk. In the turbine the steam expands right down to the lowest vacuum that the condensing water will produce, doing effective work all the way, and thereby saving a most valuable and previously wasted portion of the whole heat-drop. Moreover, with the turbine there is a complete escape from the alternate heating and cooling of metallic surfaces which was a source of much loss in engines of the older type. In still another notable respect the turbine cycle approaches the cycle of Carnot; it allows a method of regenerative feed-heating to be adopted in which some steam is "bled" at successive stages of the expansion to restore heat to the condensed water on its way back to the boiler. Finally, the steam turbine has immensely widened the range of the thermodynamic cycle by raising the upper limit of temperature through the use of higher pressure and higher superheat. A modern turbine can generate one electrical unit with a consumption of barely 1 lb. of cheap coal, which means that it converts into electrical energy fully 30 per cent. of the potential energy of the fuel. It is not surprising that the internal combustion engine finds little favour in power stations, save as an occasional standby to assist in meeting the peak load. Among other merits of steam turbine plant is its comparatively low capital cost. Published figures show that in recently equipped British power stations the cost, including land, buildings, boilers, turbines, and all electrical machinery, is from £14 to £16 per kilowatt of plant installed. For Diesel plant the corresponding capital cost is stated to be from two to four times as great.

Turning now to another field, we find that in railway traction the supremacy of steam is maintained. Higher pressures and the use of superheating have helped to hold it, and the most progressive locomotive engineers have experiments in progress which may carry practice further along these lines. Much attention has been paid to the Diesel engine as a possible alternative, but so far the number of Diesel locomotives that have found employment in main line working is a negligible proportion of the whole. If the steam locomotive is to disappear, there is no indication that its place will be taken by an internal combustion rival. What is much more likely is that it will in time be driven out—wholly or in part—by electric traction, as Lord Weir's Committee has recently suggested for the British railways. But electrification will mean that the prime mover is still steam, though acting at a central station—except, of course, in countries which have available reserves of hydraulic power.

For road motors the internal combustion engine is, of course, supreme; it has created as well as supplied a vast demand. Mr. Ricardo, writing in 1928,† said that the output of high-speed internal combustion engines exceeded by more than ten times the total horse-power of all power stations, ships and railways. A statement at the World Power Conference, held in Berlin in 1930, gave the number of motor cars on the world's roads as thirty millions, with an output of at least 600,000,000 horse-power. I have not attempted to check these estimates; I do not suspect them of exaggeration; I am only thankful that many of the engines referred to spend a great part of their time in garages and parking places and are not in a state of continuous activity. They have come into existence to meet a new need; they do not, for the most part, enter into competition with the older uses of steam, except in small ships or by diverting traffic from the railways to the roads. In their own special field—the roads and the air—they have an unchallenged monopoly. And, indeed, they well deserve it. We ought, I think to pay tribute to the constructive talent that has made these engines the convenient and reliable prime movers they have in fact become.

One may note in passing the remarkably successful efforts which have lately been made towards reducing the weight of high-speed engines which will burn heavy oil instead of petrol, with the consequent advantage over petrol of greater efficiency, less weight of fuel, greater safety, and smaller running cost. Light engines of this type open up new possibilities in the air,‡ as well as on the road and on the sea.

This brings me to the last field which must be surveyed in our brief review—the field of ocean navigation. And here we find a situation which is puzzling, unsettled, and difficult to analyse. For in the selection of prime movers for ocean-going ships there are sharp differences of opinion and of practice; there is no sense of finality; there is even—so it seems to me—a good deal of fashion and caprice, and of the probability of change which one associates with such moods of the mind. I do not suggest that superintending engineers are ever capricious or unreasoning; indeed, if the matter were really left to them I believe it would soon settle itself; but even a layman in marine matters knows that a shipping company's policy in questions of propulsion is sometimes governed by other factors than the considered judgment of the superintending engineer.

In our own Navy and foreign navies there is a practical monopoly on the part of steam except, of course, in submarines. The advent of the steam turbine, of oil fuel, of gearing between turbine and propeller shafts, of water-tube boilers, of higher pressure, and of superheating—all these progressive improvements have only consolidated the position. Foreign navies have followed the British lead, and, for surface vessels, the only departure from that rule is to be found in a new German cruiser, which is still something of a mystery ship. Except for this rare and as yet unfledged bird, naval usage sticks to steam.

But the mercantile marine is in a state of flux. Before the war there were almost no motor-driven ships. Vigorous efforts had been made to promote the use of gas engines with producer gas made on board as it was required, but these achieved no permanent success. The "Selandia," which dates from 1912, was the first conspicuous example of a large ship driven by Diesel engines. Her economy of fuel at once commanded attention. She was naturally hailed with delight by the powerful oil interests, whose position, already strong in the mercantile marine through the extended use of oil under boilers, would become impregnable if the Diesel engine were generally adopted. In some important quarters the Diesel engine became the vogue. During the post-war years of marine reconstruction, the number of oil-driven motor ships rapidly increased, and it is still increasing. In 1930, according to Lloyd's Register, the gross tonnage of the world's shipping was in round figures 69½ million tons, of which 1½ million were survivors from the ancient *régime* of sails. Of the 68 million tons that were mechanically propelled, 60 million tons were steamships and 8 million tons were motor ships. The motor tonnage had increased nearly four-fold in the preceding three years. Of merchant vessels launched during the year 1930, considerably more than half the tonnage was motor driven; and even in Great Britain the motor tonnage launched in that year was nearly 52 per cent. of the whole tonnage launched. For the moment the motor ship is in the ascendant. At this rate, a superficial observer might fancy that steam was in process of being driven off the high seas. But if that were his conclusion, I think he would be quite wrong.

If you look at the list of shipping in detail, you will notice several things. One is that none of the greatest and fastest ships are motor driven—neither the "Leviathan," which at present heads the list, nor any of the other leviathans of the deep, with their tonnages of 40,000 or 50,000 tons or more, and their speeds ranging from 20 to 28 knots. And this is true not only of the older ships, but also of the newest, such as the "Europa" and the "Bremen" and the "Empress of Britain," and the giant Cunarder which is now on the stocks and is confidently expected to eclipse them all. For such vessels, motors do not give the concentration of power that is needed, whereas turbines do give it, and give it easily. From Lloyd's list of marine engines under construction at the end of March, 1931, I find that the average shaft horse-power of the—fifty-one—turbines is nearly 20,000, whereas that of the—328—motors is not much over 2000. The present fashion, if one may call it so, is to put motors into ships of moderate size and power. The same list gives 189 as the number of reciprocating steam engines under construction. These are mainly for comparatively small and slow ships, for their average horse-power is of the order of 1000. The ocean tramp is perhaps regrettably conservative in the manner in which she uses steam, but for ships of larger power the advantage of the turbine is too conspicuous to be ignored.

Of motor-driven ships, many are tankers, a type that has been called into existence by the world's demand for transport of oil in bulk, both for internal combustion engines and for burning under boilers. Of tonnage launched during 1930, the tankers constitute more than 30 per cent. of the whole output. About seven-eighths of these are motor driven. They carry oil and, naturally enough, consume it. Motor-driven tankers account for half the world aggregate of motor tonnage launched in 1930.

It is when we turn to vessels of intermediate types, to cargo liners and passenger liners, which, though not of the largest class, are still notable ships, often catering for the luxurious traveller, that we find the liveliest contest between the steam turbine and the Diesel motor. And here one notes the curiously potent influence of nationality and of what may be called the accident of ownership. Some nations, such as Denmark, Norway and Sweden, conspicuously favour motors; others, such as America, no less conspicuously favour steam. One feels that both cannot be right. Nor can British practice, which is much divided, be right either. The choice would sometimes seem to depend more upon the taste and fancy of some dominating personality than upon a careful weighing of arguments such as appeal to engineers.

When we attempt to appraise the merits of the rivals and to estimate their chances in the more distant future, we see that from the thermo-dynamic point of view the Diesel engine still has a small advantage. On the other hand, its oil is more costly than fuel oil for boilers, it must have lubricating oil, too, and the first cost of the engine is substantially greater than that of steam plant. In respect of weight and of space occupied, there is not much to choose: when account is taken of all accessories, there is perhaps a slight advantage on the side of steam. As to durability, I cannot speak; so far as I know, there is still a dearth of published facts about the cost of upkeep with Diesel engines. *Prima facie*, the great number of reciprocating parts is a serious drawback. There must be a great number because the safe limit of cylinder size is soon reached, and it is only by having many cylinders that any large aggregate of power is developed. In a recent Diesel-engined liner of the luxurious type, a ship of some 17,000 or 18,000 tons, twelve Diesel cylinders operate on each of four shafts, making forty-eight in all, to produce a speed of 18 to 20 knots. Besides these forty-eight main cylinders, there are twenty-four more which serve purposes that are auxiliary but essential to the working of the main engines. Consider the number of working joints, of valves, of valve rods and tappets, besides pistons and connecting-rods, which this involves. Does such an accumulation of reciprocating pieces with their hammer blow accelerations mark a real engineering advance as compared with the cosy hum of a turbine engine-room, and has it come to stay? Frankly, I think not.

As a last technical point I would say a few words about fuel for marine engines. Can anything be done to re-establish the ancient connection of the merchant service with the British coalfields? Remember that here and in most other places the cost of coal is substantially less than that of oil, for the same quantity of heat. Where oil scores is in its greater convenience of handling. Much has been said and written about restoring prosperity to the miners by converting coal into oil. As a chemical operation it is quite possible to make oil from coal; as a commercial proposition it is impracticable, so long as Nature continues to supply oil directly from the bountiful stores on which man now draws with careless and prodigal ease. Ships that burn oil must have it come to them from

† H. R. Ricardo on "Light High-speed Internal Combustion Engines," Institution of Civil Engineers, Engineering Conference, 1928.

‡ See a lecture by Mr. D. R. Pye on "Heavy Oil Aero-engines," *Journ.*, Roy. Aeronautical Society, April, 1931.

sources outside Great Britain. Well, then, can we expect ships to return to the use of coal as fuel? For some classes of ships I think we may, though not all classes. Neither in the Navy nor in what one may call the upper division of the mercantile marine—the luxurious express liners which carry fastidious passengers and must keep to a time-table that means quick fuelling—can one expect a reversion to coal so long as oil fuel can be got at anything like its present price. But with cargo liners and big cargo boats the case is different. They do offer a possible field for the use of coal, a field where, I believe, its use would be economically sound as well as of great national advantage. In the running of such ships the incidental conveniences of oil fuel count for less. The cost of fuel is a relatively big factor and there is a clear advantage in being able to burn either coal or oil at option, according to the local cheapness of supply. There the geared turbine with coal fuel can more than hold its own provided the steam plant embodies the conditions that make for high efficiency, conditions which are now known to be attainable in marine practice. I think those engineers are right who contend that for such ships a highly economic mode of working would be to use pulverised coal for steam raising in a small number of large boilers of the water-tube type, with a pressure of, say, 500 lb. and a temperature of 750 deg. Fah., each boiler having its own pulverising mill and being fitted also for burning oil as an alternative fuel. In such a scheme there would be no untried elements, but the combination of the elements would be experimental, and a conclusive demonstration of its advantages can be obtained only by testing it out on a large scale in sea-going ships, trading on more than one route. An experiment of this kind is well worth the making. It is a matter of national moment to help a threatened industry by finding an increased use for coal; that aspect of it should not be overlooked by those who are willing to subsidise industrial research. Such expenditure would be a casting of bread upon the waters with a good prospect of its ultimate return.

And now, ladies and gentlemen, we take leave of our prophet of 1881. We may fancy him borne aloft in a chariot whose fires are unseen only because they burn within the cylinders. If we were to catch from him the mantle of prophecy, we should wear it ruefully; we should all be Cassandras or Jeremiahs, obsessed with the cheerlessness of the industrial outlook, and finding no escape from the conviction that the easy supremacy of Britain, as Bramwell knew it, can never be recalled. But my last word must not be an unqualified Ichabod. The engineers of to-day have as much courage and enterprise as their fathers, and they have an infinitely better understanding of the scientific principles on which, as on a smooth highway, the advance of engineering must steadily proceed. Moreover, to recognise evils, and the causes of evils, may be the first step towards their cure. The world has learnt, through a sharp lesson, that the gifts of the engineer are good gifts only if they are wisely used; that the new powers he has evoked have brought new dangers against which mankind must resolutely guard if it is to save its soul alive. The malignity of individuals and the madness of nations now command forces of destruction such as more primitive communities never knew, and were happier not to know. And apart from clamant and appalling abuses of gifts which ought to be beneficent, we have become aware of a more subtle and perhaps graver social menace. We see the mechanised arts of production over-reaching themselves, supplying commodities in a volume which cannot be absorbed, and with a facility that tends to deprive man of his richest blessing to body and spirit—the necessity of toil.

But these thoughts take us too far afield. They point to problems now conspicuously urgent, which, for the salvation of society, the engineer, the economist and the moralist must jointly set themselves to solve.

The Institute of Metals.

No. III. (*conclusion*).*

On Tuesday, September 15th, a paper entitled "The Constitution of the Alloys of Silver and Mercury" was presented by Mr. A. J. Murphy.

ALLOYS OF SILVER AND MERCURY.

The author states that the constitution of the alloys of silver and mercury has been determined over a range of temperature extending from the melting point of silver to −50 deg. Cent. Progressive additions of mercury to silver cause a continual reduction in the temperature of the initial freezing point down to −38·8 deg. Cent., the freezing point of mercury. No alloy in the series has a freezing point lower than that of pure mercury. Silver can retain in solid solution 55 per cent. by weight of mercury at 276 deg. Cent., the amount probably increasing somewhat at lower temperatures. Two intermediate phases of restricted composition are formed. The β-phase contains 40 per cent. of silver and dissociates on heating at 276 deg. Cent. into α and liquid. This phase has a close-packed hexagonal lattice, in which $a=2·98$ A and axial ratio $c=1·62$. The γ phase contains 29 to 30 per cent. of silver, and dissociates on heating at 127 deg. Cent. into β and liquid; it has a body-centred cubic lattice, with side 10·0 A. The experimental methods devised for the investigation are described, and the effect of pressure on the constitution of the amalgams is discussed.

Several members took part in the discussion, but it turned upon highly specialised points and did not present anything of interest to engineers.

A paper entitled "The Influence of Variations in Heat Treatment and Ageing on Duralumin," by Professor Zeerleder, was then read. The official *précis* runs as follows:—

HEAT-TREATMENT AND THE AGEING ON DURALUMIN.

Experiments have been made, showing the influence of the temperature of the quenching liquid and the temperature of ageing on the physical properties of duralumin (Avional). It is stated that quenching in hot water or in oil causes less deformation and that if the temperature of the quenching medium, as well as the ageing temperature, be 50 deg. Cent., they have no disadvantageous influence on the physical properties. On the contrary, measurements of the electrochemical potential, electrical conductivity, tensile and corrosion properties showed that a temperature of 145 deg. Cent. (293 deg. Fah.) had a decidedly disadvantageous influence. A possible explanation for this phenomenon is to be found in the effect of different annealing temperatures on the potential of aluminium-copper alloys. Finally, the cooling of sheet packets is examined during the period between being taken out of the heating furnace and being quenched.

Dr. K. L. Meissner said that he quite agreed with the author that, with constant temperature of the subsequent ageing, the temperature of the quenching water bath had only very little effect on the mechanical properties. That point was very important in practice. If large quantities of finished material were going to the annealing and quenching department of the works it was very difficult, owing to the relatively short time of annealing which was applied, to get the quenching water cold enough for the next quenching operation. In that respect it was fortunate that the temperature of the bath had so little effect. In 1929 he made experiments dealing with the effect of the temperature of the quenching water from 20 deg. to 80 deg. with intervals of 10 deg. The quantities of duralumin and of the water and the time of quenching in the water were held constant. The specimens were examined after five days' ageing at room temperature. No distinct difference could be found in the yield point, tensile strength, and elongation in the whole series. Another point which he would like to mention was the influence of the ageing at 0 deg. The paper showed that the rise in tensile strength and yield point were relatively small, compared with the sample aged at 50 deg. The delay of age hardening which duralumin suffered by storing in ice could be used in practice; for example, for rivets which are struck, according to the German practice, only within the first four hours of ageing at room temperature. By storing the rivets in ice it might be possible to hold the rivets in a workable form for several days. After touching upon the question of corrosion, he discussed the influence of the time between leaving the annealing furnace or salt bath and quenching in water. The author, he said, stated that only after two minutes interval there was a considerable decrease in the tensile properties. He was quite in accord with Herr v. Zeerleder that there was no need to be apprehensive about the speed of quenching. According to experiments carried out several years ago by Monsieur Lahaye, it was possible to obtain with 0·5 mm. duralumin sheet about the same tensile properties by cooling in air as by quenching in water.

Professor Hanson said that duralumin was somewhat exceptional amongst high-strength aluminium alloys, in that it attained practically its best properties by ageing at ordinary temperatures; whereas practically all its rivals required to be aged at a higher temperature. He believed that by a study of impurities or small amounts of additional elements improvement in results might be achieved without recourse to ageing at high temperatures, which appeared to produce a constitutional change associated with somewhat undesirable chemical behaviour.

Dr. Rosenhain said that unfortunately there was one property of duralumin which was very much improved by ageing at a high temperature as against its behaviour when aged at room temperature, and that was permanence of dimension. It had been clearly shown in a paper published before that Institute a year ago that by ageing at 100 deg. Cent. the tendency of a heat-treated duralumin forging to undergo changes of shape after subsequent machining was very much diminished, and it was most unfortunate that that highly desirable state of affairs should be correlated with a particular tendency towards corrosion, and especially towards inter-crystallisation corrosion. He was inclined to take the view that perhaps there was a difference in the mechanism of ageing—probably the precipitation of a different phase at the higher temperature—from what there was at the lower one. At all events he would suggest, contrary to Professor Hanson, that metallurgists should try to find a duralumin, or a duralumin-like alloy, which could be aged safely at 100 deg. Cent., so as to diminish the risk of subsequent distortion, without increasing its tendency to corrosion.

Mr. Evans said that some four or five years ago he carried out at Cambridge a number of measurements of the E.M.F. of the cell set up between various metals and iron at different times after the liquid came in contact with the metals in question. In the case of many metals it was found that the polarity towards iron varied very much with the time. The metal might be anodic at one time and cathodic later, or sometimes cathodic first and then anodic towards iron. Under the conditions studied, aluminium was, in most liquids, anodic towards iron; but the surface of both metals was an especially abraded one, which did not correspond exactly with service conditions. Nevertheless, that observation, namely, that aluminium was normally anodic to iron, did seem to correspond with the observations which had since been made on aluminium-coated iron specimens, where undoubtedly the coating was anodic to iron, for it was found in many liquids that the coating might be scraped away to expose the iron below, and yet there was absolutely no rusting. The exposed iron remained perfectly bright. The aluminium was attacked and gave cathodic protection to the iron. Those experiments were made with commercially pure aluminium.

Dr. Zeerleder, in reply, said, concerning the observation of Dr. Meisner that he found a termination of the ageing in ice water only after a long time, and that a very small difference in the composition of the duralumin had a very marked influence on the ageing speed. Replying to Dr. Rosenhain, he thought it would perhaps be possible to have the duralumin first aged at normal temperature and then, after the ageing was absolutely finished, to treat it for a short time at 100 deg., because the influence of further ageing at 100 deg., if it was not too long—say, one or two hours—would be capable of changing the tensions in the surface, but not changing the potential.

The following papers were then taken together:—"Experiments in Wire Drawing: Part I., Behaviour of the Composite Rod," by Messrs. Alkins and Cartwright, and "The Drawing of Non-ferrous Wires," by Messrs. Francis and Thompson. The official abstracts of both papers are printed below:—

WIRE-DRAWING: BEHAVIOUR OF A COMPOSITE ROD.

Composite round rods of annealed copper, built up by drawing a number of tubular layers of equal thickness over a central solid core, have been drawn in drafts of varying severity through straight-sided dies of three angles of taper. It has been found that butt ends, when drawn through the dies, become concave without showing any steps between the layers; the concavity increases with the angle of taper of the die and also with the amount of reduction at the draft. It has been shown that all the layers undergo a proportionate reduction in thickness and, therefore, the same relative reduction in area of cross section.

The boundary surfaces between successive layers, which are cylindrical in form, both before and after drawing, assume in the reduction zone the form of surfaces of frusta of a series of cones of common axis and common apex; the apex of these cones is identical with that of the cone defined by the bearing of the die. The more nearly the individual layers lie to the centre of the rod the further back from the emergent side of the die is reduction found to commence and to finish. The *loci* of incipient reduction, of equivalent stages of reduction and of completed reduction are a series of spherical caps, radially parallel to one another and bounded by the bearing of the die, all of which have a common centre at the apex of the cone, the surface of a frustrum of which forms the bearing of the die. Reduction thus appears to be effected by pure shear stress.

It is suggested that the behaviour of these composite rods is exactly comparable with that of solid round rods under similar conditions.

THE DRAWING OF NON-FERROUS WIRES.

The power required to draw wire is shown to be directly proportional to the maximum stress of the original material. With tungsten carbide dies, the pull required is shown to be practically independent of the speed of drawing over a wide range. A comparison is made between the efficiency of steel, carbide and diamond dies. Further proof is advanced that the power requirements are directly proportional to the reduction of area. The influence of the angle and contour of the die is investigated under various conditions. The problem of lubrication is discussed, and an attempt made to estimate the coefficient of friction between the wire and the die.

Dr. A. D. C. Gwyer said that the first paper constituted, in his opinion, a most valuable contribution to wire-drawing practice. It was essentially practical. Its great value lay in the fact that so many of the facts had a very direct bearing upon the economics of production. The practical man, for example, wanted to know the maximum reduction which could be given per draft, having regard to the capacity of his plant. Every draft saved was of value, and that was particularly true with fine wires. The authors dealt with the fixed reductions per draft, and had studied die angles and lubricants. He suggested that they should go further and study those factors with the maximum possible reductions before a fracture occurred. The experiments upon optimum die angle in relation to power requirements were of very great importance, and the respective merits of straight and radial tapered dies had been clearly discussed. He thought that was a line of investigation which might be profitably extended. The superiority of the straight taper die, as compared with the trumpet or radial die was most striking, but it would be interesting to know whether the authors had considered, or would consider, the question of a multiple angle die. In practical work not only had the power factor to be considered, but also the life of the die, and in his experience of aluminium he found that the multiple angle die possessed advantages over the straight taper die from that point of view. The authors had stressed, he thought rightly, the question of the material used for making the dies. The efficacy of a material analogous to the bearing metals should be obvious, but the point was one that was often overlooked by the practical man. With regard to the paper by Messrs. Alkins and Cartwright, he asked if they were justified in suggesting that the behaviour of composite rods was exactly comparable with that of solid round rods under similar conditions. He was very interested to note their conclusion—page 3—that the area of the central rod and that of each layer underwent exactly the same percentage reduction.

Dr. Rosenhain said that whilst there was no doubt sufficient similarity to render the observations on the composite rod very interesting, he thought that there

* No. II. appeared September 25th.

was sufficient difference to make it necessary to be cautious in drawing conclusions from one to the other. He asked if would not be possible to solder the various layers together in order to get a little nearer the nature of the solid rod.

Dr. Brownsdon referred to the temperature of the dies. With the different rates of drawing there must be different temperatures set up in the dies which would vary the friction coefficients and alter the viscosity of the lubricant. That point should be most carefully observed before any conclusions were drawn as to the relative powers required for different types of dies; because there was one very important underlying feature in the whole of commercial wire drawing, namely, that the lubricant probably played the part of a coolant rather than a lubricant.

Mr. Price mentioned that in America for wire drawing, especially brass wire, fermented rye middlings mixed with water, which exerted a certain biting action, were used.

Professor Thompson, in reply to the discussion, said he agreed that the temperature of the die ought to be measured. They had done it for a steel die up to a speed of 60ft. a minute with an annealed brass and a reduction of area of 20 per cent., and the best soap lubricant they could adopt. If he remembered rightly, there was a rise of temperature of the wire die of the order of 110 deg. That was a very big rise. They had a water-cooling arrangement, but in no case had it been found necessary. If there was any undue heating in the die which was putting up the coefficient of friction, or anything like that, the independence of pull and speed would no longer hold.

Mr. Alkins, replying on behalf of Mr. Cartwright and himself, said that their difficulty was to get the layers apart once they had drawn them. The position was that in the annealing, which they regarded as essential prior to their cold drawing, crystals grew straight across the layers, and when they tried to strip the layers apart, the contact surfaces between the layers all came up frosted.

The following two papers were then taken together :—"Application of the Spectrograph to the Analysis of Non-ferrous Metals and Alloys," by H. W. Brownsdon and E. H. S. van Someren, and "The Spectrographic Assay of Some Alloys of Lead," by D. M. Smith. We give below the official abstracts of these papers :—

ANALYSIS BY THE SPECTROGRAPH.

The value of the spectrograph for the detection and estimation of small quantities of impurities and minor constituents in metals and alloys does not appear to be fully appreciated by chemists and metallurgists, and some reasons for the slow development of spectrographic methods of examination are suggested. The spectrograph is considered as an essential part of the equipment of a metallurgical laboratory. The possibilities and limitations of spectrographic methods are reviewed. Methods for the routine spectrographic examination of brass and some lead alloys are outlined and tables are given indicating the relationship between impurity or minor constituent concentration and relative line intensities.

THE SPECTROGRAPHIC ASSAY OF LEAD ALLOYS.

An account is given of the application of the spectrograph to the quantitative determination of low percentages of tin, antimony, and cadmium in lead alloys; a routine method is described specially applicable to the binary and ternary alloys of lead used in cable sheathing, &c.

The method is based on standards of known composition, either synthetically prepared or determined by accurate chemical analysis. One of its great practical advantages is that it is very much more rapid than ordinary chemical assay of these metals. Spark spectra are preferred as giving more consistent results than are spectra.

By simple direct comparison of spectra the constituents can be determined within the range 0·1–1 per cent., with an accuracy of 10 per cent.—thus, a percentage of 0·25 would be determined with certainty as being between 0·22 and 0·28 per cent.—and by the application of the logarithmic sector method a similar accuracy for a range up to 3 per cent. tin can be obtained.

Dr. R. S. Hutton said he was very glad that the Institute had had an opportunity of having that matter brought before it because, although the whole technique of the science of spectroscopy applied in that way was by no means novel, it seemed to take a tremendous time for the industry to realise its practical value and utility for every-day work. The real importance of the subject was such that he felt exactly as Dr. Brownsdon said—that they all ought to be strongly advised to acquire spectroscopes and utilise them at the earliest possible moment; in fact, they were wasting time and money by delaying to do so.

Professor Hanson said that there was no doubt that that method did represent a quick and accurate method of estimating the composition of an alloy within well-defined limits; but a real difficulty in the widespread use of spectrographic analysis was that one must have either some well-established method of making the estimation of internal standards, or one must have available, as the alternative, some really reliable standard samples with which to make the photometric comparison.

The President, in concluding the debate, said that the subject was of very great importance, and he hoped that the Institute would hear a great deal more about it in the future.

Several other papers were taken, but in view of the present heavy pressure upon our space, and the fact that they were rather of specialised interest, we are unable to deal with them.

A SEWERAGE scheme for the Droitwich Town Council is to be carried out at a cost of £28,000.

A Petrol Engine Driven Rail Coach.

No. II. (*conclusion*).*

IN our last issue we described at some length a petrol engine driven rail coach constructed by the Drewry Car Company, Ltd., for the Bermuda Railway. The transmission gearing between the engine and the wheels still remains, however, to be described. The transmission is effected through a Wilson-Drewry five-speed, preselective gear-box of the epicyclic type, of which we publish photographic reproductions and drawings.

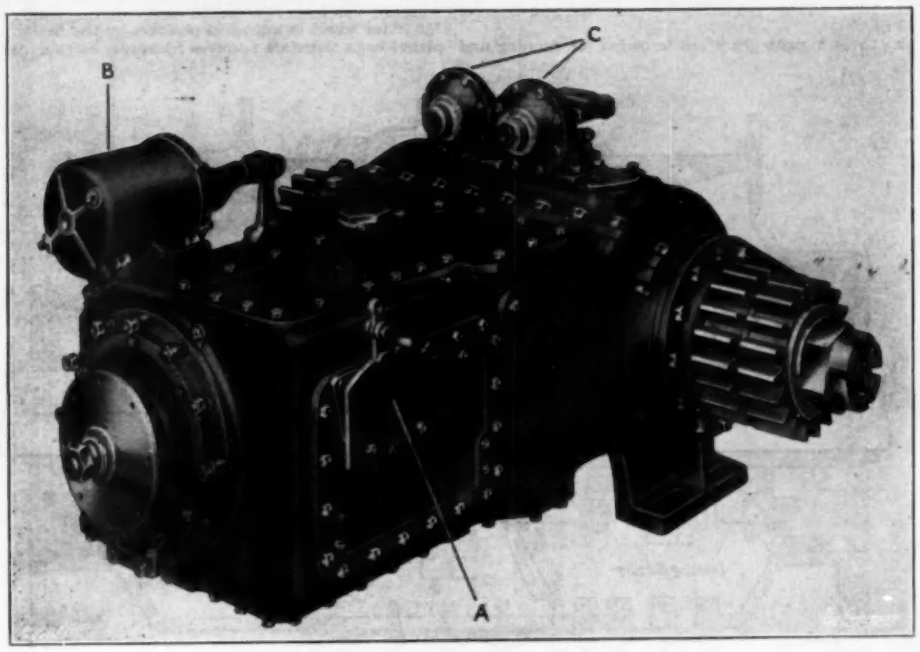


FIG. 1—THE GEAR BOX

The appearance of the exterior of the gear-box can be seen from Fig. 1. The gears themselves and the final bevel drive, with which is incorporated the reverse gear, are all housed within this box, which is situated at the rear end of the power bogie behind the rear wheels. Gear-changing is controlled pneumatically from the driver's cab by means of a cylinder and diaphragms mounted on the top of the box. The two diaphragms indicated at C control the reverse mechanism through a tiller arrangement, the air pressure within the one concerned in making the latest movement being maintained to hold the tiller in the position to which it has been moved. The lever A is connected mechanically with the selector handle in the driver's cab, and is responsible for controlling the pre-selective mechanism, while the large cylinder B operates the engage gear mechanism. This cylinder automatically releases the gears rapidly, but on the return stroke of the piston when a gear is being engaged, air from within the cylinder is released slowly through a restricted opening, so that the gear is let in gently, and responsibility for its quiet engagement does not rest with the driver. The final drive to the wheels is through chains, the sprocket wheels for which can be seen in the engraving.

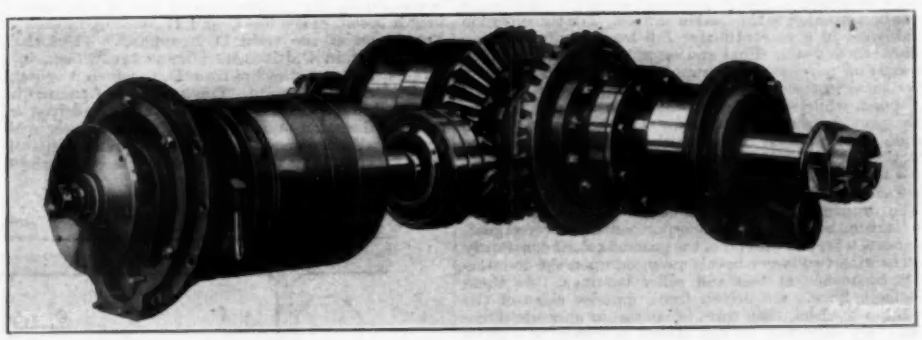


FIG. 2—BATTERY OF GEARS, BEVELS, AND COUNTERSHAFT

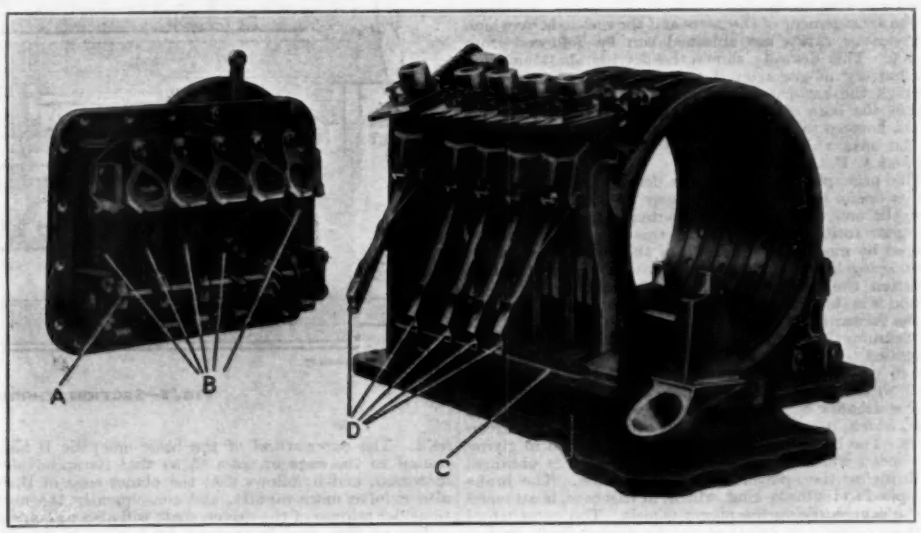


FIG. 3—THE BRAKES AND SELECTIVE MECHANISM

The arrangement within the gear-box is shown in Fig. 2, in which the gear battery, the bevels of the final drive, and the countershaft can be seen. Around the gear battery, the brake bands, of which we reproduce a photo-

* No I. appeared September 25th.

graph in Fig. 3, are fitted, together with the pre-selective mechanism.

We have already noted that the gear-box gives five speeds, the ratios and efficiencies, as given to us by the makers, being as follows :

Gear.	Ratio.	Efficiency, per cent.
5th	1 : 1	99·25
4th	1·49 : 1	99·25
3rd	2·36 : 1	99·0
2nd	4·15 : 1	98·75
1st	10·5 : 1	98·5

There is a fixed reduction behind the gear-box of 4·25 : 1.

The three highest gears are intended for running and therefore have fairly closely spaced ratios. They are suitable for use on large gradients, or against headwinds, and, it is believed, will be useful if an extra trailer or a horse-box is added to the load in service. The transmission is designed to give continuous full load running on any of these three gears. First and second speeds are provided for starting purposes. Bottom gear is designed to give a drive between the engine and wheels at the lowest possible car speed, while second gear, which can be engaged very early, provides a ratio suitable for rapid acceleration. Full torque is not applied through either of these gears, since adhesion would then be overcome, but the greatest possible drive on the wheels, it is claimed, is constantly obtained right through the gears at the best engine speed.

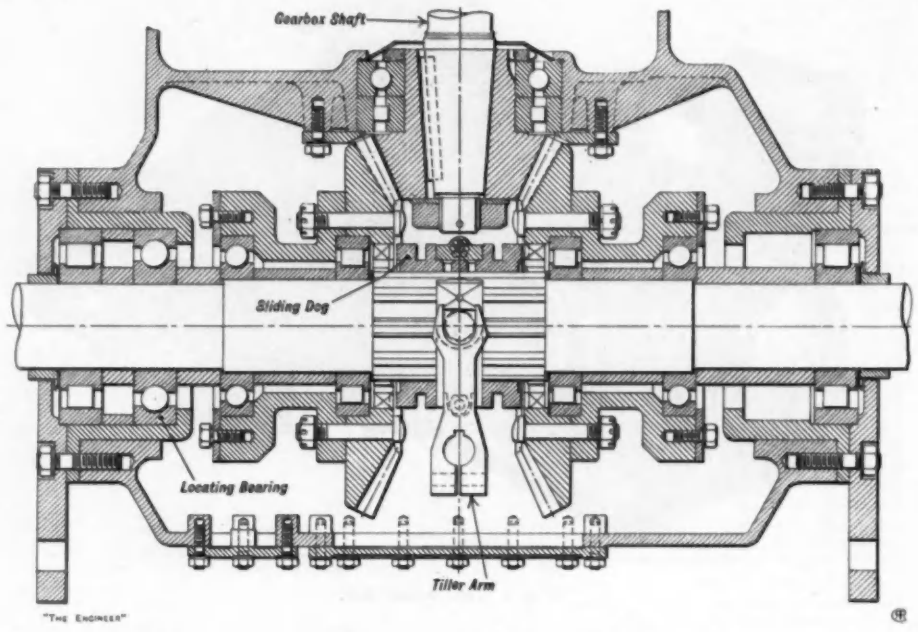


FIG. 4—DETAILS OF THE FINAL DRIVE

The drawing, Fig. 4, gives details of the final drive mechanism, with which is incorporated the reverse gear. The bevel wheel on the end of the gear-box shaft constantly meshes with two larger bevels mounted upon the countershaft by means of ball and roller bearings. As these two large bevels are driven from opposite sides of the small bevel wheel, they turn, of course, in opposite directions. By engaging a dog clutch mounted on splines cut on the countershaft between the two bevels with one or the other, the rotation of the shaft can be altered at will from one direction to the other, the drive being equally efficient in either direction and independent of the gear-box. The sliding dog is controlled by the tiller, which is operated by the diaphragms mounted upon the top of the casing referred to above. The top of the casing above the bevel drive is split at an angle of 45 deg. to the horizontal, so that the whole of this mechanism can be lifted out with the cover.

The arrangement of the gears and the methods by which the various ratios are obtained can be followed from Fig. 5. This drawing shows the driving shaft entering the battery of gears on the right. It penetrates right through the battery and is finally supported by a bush within the bore of the driven shaft, which projects out of the battery to the left. There are four epicyclic trains in the box, which, for clarity of description, have been marked A, B, C and D.

The principle underlying the design of the gear-box is that one of the trains—in this case B—shall be the basic epicyclic and that the others reacting upon it shall alter the gear ratio it provides. In this box the ratios are altered by modifying the speed of the outer wheel of the basic epicyclic. For first gear this wheel is rotated in a direction the reverse of that of the driving shaft, for second it is stationary and for third and fourth it is moving in the forward direction.

Beginning, then, with the simplest drive, the brake is applied to epicyclic B, the other brakes being released. The drive then passes from the sun wheel on the driving shaft to the planet wheels, which, the outer wheel being held stationary by the brake, carry with them the planet cage, which, it will be observed, is attached to the driven shaft. The basic epicyclic B alone is concerned in giving this speed which is second gear. First gear is obtained by bringing the epicyclic train A into use. The brake is applied to its brake ring, which, in this case, is attached to the cage carrying the planet wheels. The outer wheel of this epicyclic is attached to the driven shaft, and it therefore travels at the same speed as the cage of epicyclic B, which is also attached to that shaft. Since the cage of epicyclic A is held stationary and the outer wheel is revolving in the same direction as the driving and driven shafts, the sun wheel of that epicyclic revolves in the opposite direction, carrying with it the outer wheel of the basic epicyclic B. The conditions at the latter epicyclic are therefore as follows. The sun wheel is revolving forwards at engine speed while the outer wheel is being rotated by the epicyclic train A in the reverse direction. The planet cage, therefore, travels forwards at a speed considerably slower than that at which it would move were the outer wheel stationary. As the planet cage of the basic epicyclic is attached to the driven shaft, the latter also travels more slowly. In this way, first speed is provided.

For third speed the brake is applied to the epicyclic train C, all other brakes being released. The sun-wheel of this train is attached to the driving shaft, while the outer wheel is locked in position by the brake. The planet cage therefore revolves forwards, carrying with it the outer wheel of the basic epicyclic B, and thus increasing the speed of rotation of the cage of that epicyclic, and consequently the revolutions of the driven shaft. For fourth speed, epicyclics C and D react upon each other. The brake of the train D is applied. Then the sun-wheel of train C drives its planet cage, which, in turn, rotates the outer wheel of train D, to which it is attached, in the forward direction. The sunwheel of train D is held by the brake. Hence the planet cage is driven in the forward direction and carries with it the outer wheel of train C, with the consequence that the planet cage of this train travels faster than it did when its outer wheel was held. The outer wheel of the basic epicyclic B is connected to the cage of train C, so that its speed also is increased, and it follows that the planet cage of B must also revolve more rapidly, and consequently the revolutions per minute of the driven shaft will also be increased.

Top or fifth gear is engaged by letting in the direct drive clutch when all the epicyclics acting as a multiplate clutch revolve together. For reasons connected with the selective mechanism, which will be explained later, it is necessary to bring the clutch into action by a rotary motion and part of the quick-acting screw mechanism can be seen behind the clutch. All the gears are lubricated from an oscillating cylinder reciprocating pump, the oil passing down a hole along the centre of the driving shaft and being flung out through cross holes. The position of the pump can be seen in the drawing.

From the above description, it will be observed that a change of gear is effected by the application of brakes to the epicyclics. It is in connection with the mechanism that performs this function that the pre-selective qualities of the gear-box are obtained. In the following description the index letters refer to parts shown on the engraving, Fig. 3, and the drawing, Fig. 6.

Beginning with the brake bands themselves, it will be seen that each can be contracted around the epicyclic drum by a movement of the rod F towards the stop G. The links and levers which perform the function are easily followed on the drawing. The gear engagement lever, which is not shown in the drawing, operates the bus-bar C, which, as can be seen from the engraving, Fig. 3, extends the full length of the box. Connection between the bus-bar C and the rods F is made by means of the struts D, which are held away from the bus-bar by springs. Their lower ends rest against the plates B, which are forced against the faces of a set of cams on a cam shaft A by springs sufficiently strong to overcome those actuating the struts. The lever E is connected with the selector handle in the driver's cab, and is capable of rotating the cam shaft A. When any particular gear is selected, one of the plates B is allowed by its cam to come forward and press back the corresponding strut against the bus-bar. Owing to the fact that the bus-bar is normally in the raised position, however, the strut does not at once engage with it. As soon, however, as the driver operates the gear engagement lever in the cab, the bus-bar is lowered and the strut engages with it, with the consequence that the corresponding brake is applied when the bus-bar again rises. Another gear may be now pre-selected by rotating the cam shaft, but the first strut cannot come out of engagement with the bus-bar until the latter is lowered once more.

It was stated when the gear-box was being described that it was necessary to bring the top gear clutch into action by a rotary motion. The reason for this necessity will now be clear, since the clutch must be actuated by a mechanism of a nature similar to that by which the brakes are applied.

There are certain refinements in the design of this pre-selective mechanism which are worthy of notice. The brake linings themselves are in two parts for each drum, the gap in the lining of one part being on the opposite side of the drum to that of the other. The mechanism is so arranged that the movement of the rod F contracts both simultaneously. A device is incorporated to prevent two gears being engaged simultaneously, an accident which would cause great wear of the brake linings concerned, and would generate considerable heat very rapidly. On the cover which carries the cam shaft a number of curiously shaped lugs H are carried on screws in such a way that they can rock. Each of the struts has a projection. The lugs H are so spaced that the clearances between them when added together are just equal to the width of one of the projections on the struts. Consequently, since the projections must pass between the lugs before the struts can be engaged with the bus-bar only one strut can be engaged at one time. So effective is this device that neutral gear is obtained by attempting to engage two gears at once, with the result that both the struts are held out of engagement.

In the course of time wear will take place at the brake

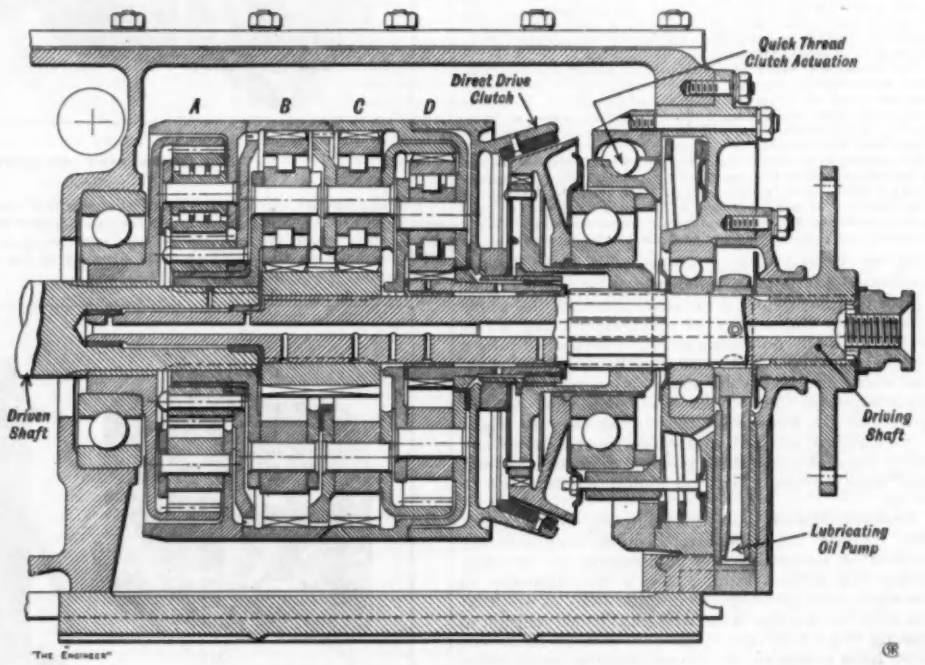


FIG. 5—SECTION THROUGH THE BATTERY OF GEARS

linings, and compensation is provided for this eventuality in an ingenious manner. It will be seen that near the top of each of the rods F, which bring the brakes into action, there is a fulcrum, the position of which relative to the rod is controlled by a nut. Beneath the nut there is a plate cut into the general form of a diamond, and around the nut there is a ratchet spring. When the brake lining wears, the rod F swings further across and the edge of the diamond plate comes into contact with the stop G and the plate is rotated. Owing, however, to the action of the ratchet spring, it does not carry the nut with it. On the return of the rod the diamond plate comes into contact with a pin, which turns it back again to its original position,

PRE-SELECTIVE MECHANISM FOR FIVE-SPEED COMPOUND EPICYCLIC GEAR

IMPROVED GEARS, LTD., WESTMINSTER, ENGINEERS

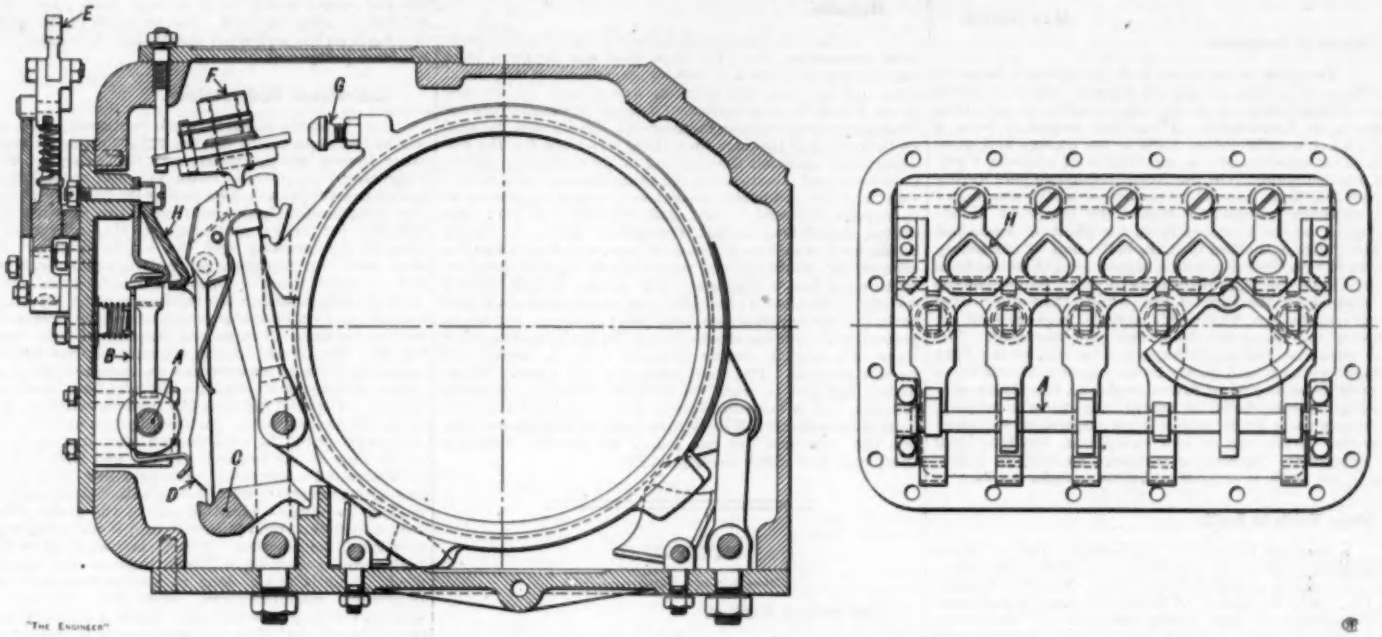


FIG. 6—THE BRAKES AND THE PRE-SELECTIVE MECHANISM

and this time it rotates the nut and so alters the position of the fulcrum, and thus automatically takes up the wear in the brake lining.

Lastly, it is desirable that the bus-bar should be exerting the greatest force when it is in the raised position, owing to the fact that it is here that it applies the load to the brake. It is held in this position by a spring. But, of course, if this spring acted directly upon it, the least force would be exerted when the bus-bar was raised. To get over the difficulty, the spring is arranged to act upon the bus-bar through an arm of which, by an ingenious mechanism, the length can be altered so that the moment exerted by the spring to lift the bus-bar increases, although the actual pressure provided by the spring decreases.

Although it is complicated to describe, the gear is very simple to operate. The controls for the gear-box, which were described in our last issue, consist of only two handles, the selector lever and the gear engagement lever. The gear-box and final drive were designed for the Drewry Car Company, Ltd., by Improved Gears, Ltd., of 23, Queen Anne's-gate, London, S.W. 1. The latter firm has applied the principles of this pre-selective gear to many uses, including the transmission of motor cars, lorries, and motor boats.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Improved Industrial Prospects.

THE development of the exchange situation and the settlement of the tariffs question are awaited with eagerness by industrialists in the Midlands and Staffordshire, many of whom believe this country to be on the verge of a new era of industrial prosperity. Certainly the suspension of the gold standard and its effect upon sterling have put a new complexion on the iron and steel situation. Hopefulness has been reinspired, and the Birmingham Iron and Steel Exchange this week wore more of its old-time appearance. The tone of the market was brighter and more confident. Pointers to coming prosperity are beginning to take shape, and a revival of industry is almost counted upon. Foreign rivals to Midland manufacturers of iron and steel have been struck a heavy blow, and it is thought a further one is in store for them. There is already talk of foreigners establishing works here in Birmingham and inquiries for sites have been received by City officials. The lower value of the pound has had the effect of opening up foreign trade and of curtailing sales of foreign products in this country. Business throughout the Midlands is improving in tone, and firms are preparing for a definite revival.

Steel Semis Advance.

The first effect of the new exchange situation on the iron and steel market is to put up prices of steel half-products produced in this country by 2s. 6d. to 5s. per ton. Continental materials are temporarily off the market. Users here hesitate to trade on a dollar or a franc basis, and in the present confusion business is dormant. Local consumers appear to have ample supplies for the moment, for they are not covering themselves by buying native products. Home makers of billets and sheet bars who recently brought down prices to compete with the foreigner are now holding out for more remunerative rates, and although at the time of writing the general rise in values was as stated above, it is quite likely that before these lines appear in print, they may have appreciated further. To-day billets are named £5 2s. 6d., and small bars £6 10s. minimum. Sheet bars are £4 15s. minimum. Finished steel prices shown no change, angles being £8 7s. 6d., tees £9 7s. 6d., joists £8 15s., ship, bridge and tank plates £8 17s. 6d., less their respective rebates. Business is still poor in the heavy engineering trades in this area, and there is no large amount of buying of finished steel materials.

Pig Iron.

There has been a definite increase in the amount of pig iron buying since my last letter. Midland furnacemen and merchants state that the volume of business done has been much greater than for some time, and that there has been a desire on the part of some users to enter into contracts. Little, if any, increase in the consumptive requirements of foundries is in evidence in this area, and it seems probable that nervousness is at the bottom of this buying movement. No one is quite sure as to the effect of the new outlook on coke and pig iron values. Of course, until a week ago, there was just a possibility that the Central Pig Iron Producers' Association would, at its meeting, make an advance in selling rates, particularly in view of the tendency for production costs in the shape of fuel to rise. The Association has now, however, announced its intention of maintaining recent selling rates, at all events, for the present. There has been a good deal of movement this week on the part of users desirous of renewing stocks which have been allowed to dwindle almost to nothing. Pig iron demand as it stands at present can be readily met by existing stocks and current output, and it will need a continuance and expansion of the present demand for some time before the necessity arises for putting additional pig iron producing plant into operation. It is hoped that progress will continue, but there is little tangible evidence of the necessary movement at the foundries and forges in this district. Values of Midland brands of pig iron as reaffirmed by the Producers' Association are:—Northamptonshire forge, £2 17s. 6d.; No. 1 foundry, £3 5s. 6d.; No. 2, £3 4s. 6d.; No. 3, £3 2s. 6d.; No. 4, £3 1s. 6d.; Derbyshire forge, £3 1s.; No. 1 foundry, £3 9s.; No. 2, £3 8s.; No. 3, £3 6s.; No. 4, £3 5s., delivered at stations in the Black Country and subject to rebate.

Coke Values.

Blast-furnace coke, which has been cheap of late, may possibly increase in value in the near future. With a large number of blast-furnaces out of commission, users have had control of the market and producers claim that some of their output has been disposed of at an uneconomic rate. Midland smelters have, in many instances, been getting supplies at about 10s. 6d. per ton. This week it is slightly dearer at 11s. If the stimulus which coke generally derives in the autumn from expansion of domestic demand should coincide with increased sales of furnace coke abroad, as a result of the depreciation of sterling, values would probably advance much further. The position is being closely watched by owners of blast-furnace plant in the Midlands.

Staffordshire Manufactured Iron.

In the Staffordshire finished iron trade the chief interest lies in those branches which consume continental raw material. Ironmasters who have adapted their plant to the re-rolling of continental semis are watching the market closely and have already put up their selling prices. Makers of nut and bolt bars are wondering whether at last they are going to be in a position to compete for local manufacturers' orders. For years past continental No. 3 iron has been obtainable at such a price that local ironmasters had no chance of selling their iron in the open market. There has been an increasing use in Black Country works of foreign raw material, and Staffordshire ironmasters have had little to do in this department. They complain of the heavy dumping during recent weeks of foreign material into this district, and the difficulty of obtaining orders is as great as, if not greater, than it was a month ago. Whether under the new conditions prices of native and foreign common bars will become more akin remains to be seen, but ironmasters are not without hope. It was practically impossible this week to get a quotation from importing merchants for Belgian No. 3 iron. Staffordshire nut and bolt bars continue to be rated at £8 7s. 6d., and gas tube strip at £10 10s. to £10 12s. 6d. Conditions in the marked bar branch of the trade are unaltered as are prices at £12 per ton at makers' works. Crown quality iron is named £9 5s. upwards delivered.

Rise in Sheet Values.

The recent steady decline in values of galvanised sheets has been arrested, and prices are now moving upward. For some time manufacturers have been operating on an unremunerative basis, but the rise in prices of spelter and sheet bars combined with an improvement in buying of sheets by overseas users, has enabled them to make a bid for an economic price. The minimum for 24-gauge galvanised corrugated sheets, which, when I wrote last, stood at £8 15s. per ton, has been raised by 10s. per ton to £9 5s. In cases where recently £9 per ton was quoted, £9 10s. is now asked, and this figure applies, in many cases, to small tonnage orders for home consumption. South America and South Africa are both buying more freely than they were, and there are hopes of a growing demand in the near future. A few mills have placed limitations upon delivery dates. Business is less sluggish in the tin-plate market here, and prices are up by about 1s. to 13s. 6d.

Heavy Edge Tools.

A slight improvement has taken place in the heavy edge tool-producing works in this district. For many, many months now a state bordering on stagnation has existed in this industry, and the orders which have recently come in, though they are not in the main for any appreciable quantity, are very welcome. The works are only partially employed, but additional hands have been engaged at some establishments. It is hoped the improvement will prove a lasting one.

Motor Engineering Success.

The Austin Motor Company has had another successful year, and the announcement of a dividend of 100 per cent., less tax, on the ordinary shares, is very satisfactory. The year's working is said to constitute a record, and it is noteworthy that sales in the home markets show an advance on the previous year of 26 per cent.

West Bromwich Firm's Trading Account.

Despite the depression in trade during the past twelve months, J. Brockhouse and Co., Ltd., spring and axle manufacturers, of West Bromwich, have an available balance for distribution of £26,000, and the directors propose to pay a dividend of 6 per cent. for the year and to carry forward £12,767. Sir Harris Spencer, at the thirty-fourth general meeting of the company, stated that they had installed at the works some of the most modern hammers on the market, and they now had some of the most up-to-date plant that it was possible to buy. That would, no doubt, tell its tale when the time came.

Unemployment.

Unemployment in the Midlands area continues to grow, the latest returns showing an advance on the week of over 2000. There are now in the division 270,580 wholly unemployed, 126,721 temporarily stopped, and 672 normally in casual employment, making a total of 397,973. The figures are slightly up in the Birmingham area and slightly down at Stoke-on-Trent, while, in the Black Country, increases are recorded at Cradley Heath, Smethwick, Wednesbury, Tipton and West Bromwich, and decreases at Bilston, Dudley, Oldbury, Walsall, Wolverhampton and Stourbridge and Brierley Hill. At Northampton there is an increase and at Nottingham a decrease.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Industrial Prospects.

THE past week or so, with its changed financial conditions, has bred a crop of reports, many of them grossly exaggerated, as to the improvement in industrial prospects in Lancashire. There has certainly been a reopening of several cotton mills in the county and some measure of improvement in the volume of trade in Yorkshire woollen goods. On the Royal Exchange here during the past few days, Lancashire makers of textile machinery were therefore inclined to regard the prospects of improvement in the home markets for plant as somewhat brighter, although there is little indication of machinery exports of this class reaching a higher level than has been the experience throughout the present year. Some machine tool makers in the district are busier than they were several months ago, but in this case the improvement set in before the departure from the gold standard. The latter event is confidently expected to benefit the light castings industry, and partly in anticipation of this there has been more buying of raw material on the Manchester markets. Some electrical engineering firms are busy, and others seem to be rather more hopeful as to future prospects. With one or two exceptions, constructional and locomotive engineering concerns, as well as boilermakers, are badly in need of additions to order books.

From North to South.

Another Lancashire engineering firm to select the southern part of the country as the scene of its industrial activities is announced this week. Browett, Lindley and Co., Ltd., engineers, of Patricroft, near Manchester, are to transfer to new works situated at Letchworth, Hertfordshire. The services of the chief engineer and certain members of the technical staff are to be retained, and the transfer, it is understood, is to commence at the end of the present week.

Industrial Results.

A reduction in the net profits for the twelve months to the end of last June is announced by the directors of Ferranti Ltd., electrical engineers, of Hollinwood, Manchester. They amount to £60,689, compared with £68,749 in 1929–30, and £66,976 in 1928–29. After paying the dividend on the 7 per cent. preference shares and a distribution of 6 per cent., less tax, on the ordinary share capital, and also meeting the expense incurred in the capital increase and reorganisation, there is a sum to be carried forward of £35,980. In their recent annual report for the year to the end of March, the directors of Larmuth and Bulmer, Ltd., engineers, of Salford, stated that the Newcastle branch of the company had sustained a loss, but that the Salford branch had been more fortunate. The result was a reduction in profits from £12,741 in the previous year to £161. It is now announced that the half-year's dividend on the preference shares, due at the end of September, will not be paid.

Non-ferrous Metals.

Movements on the non-ferrous metals markets during the past week have again been of considerable interest, and further appreciable price increases have to be recorded compared with a week ago. With the exception of lead, however, none of the metals has maintained the highest points reached since the advancing movement set in. On balance tin is dearer by nearly £5 a ton or about £10 below the peak. As with most other sections of the market, the rise was owing mainly to the operations of speculators, although industrial consumers have also displayed more buying interest. Tin's decline from the highest set in in the early days of the present week, but even at the levels now ruling values are better than they have been at any time since about the middle of March. Trade buying in the case of copper has been on rather more cautious lines, but with speculators active there has been a net advance on the week of a little over £3 a ton for standard brands, thus bringing quotations back to where they were two months ago. The recovery in lead has been particularly marked, and it is necessary to go back to early in the year to find the equivalent of current prices. The week's rise has amounted to about £1 10s. a ton, and a better demand for the metal from users in this country has been experienced. This has also been reported in respect of spelter, which, compared with a week ago, is 7s. 6d. to 10s. a ton dearer.

Iron and Steel.

More active conditions have been witnessed in the pig iron section of the Lancashire markets and, continuing the buying improvement which set in early last week, foundries have been covering prospective needs up to the end of December. Whilst most of the increased interest in the market has been in the nature of a precaution against higher prices, it has also been due to a minor extent to actual or potential improvement in trade prospects. The present tendency of prices is undoubtedly firm, with Staffordshire, Derbyshire, and Cleveland makes of pig iron at 67s. per ton for delivery equal to Manchester, Northamptonshire at 65s. 6d., Scottish at about 86s. 6d., and West Coast hematite at 81s., although in the case of the last-mentioned product an almost immediate advance was expected. There has been no change in bar iron and the demand has remained rather quiet. Lancashire Crown quality bars are quoted at £9 15s. per ton and No. 2 material at about £8 5s. Whilst rollers of heavy steel products have experienced no appreciable increase in the demand there has certainly been a little more inquiry about, and in view of the steadier undertone of the market it is probable that a bigger tonnage will be bought before long. Boiler plates are quoted at about £8 17s. 6d. per ton for both acid and basic sorts, ship and tank plates at £8 17s. 6d., sections at £8 7s. 6d., joists at £8 15s., large diameter bars at £9 7s. 6d., and small re-rolled bars at £6 10s. With continental makers still refraining from quoting on a firm basis, the market for imported materials has been featureless.

BARROW-IN-FURNESS.

Hematite.

The present position in the hematite pig iron trade is an interesting one. The fact that two furnaces have begun producing again at Barrow seems to have convinced some people that the decision was caused by the fall in the £ and the anticipation of a bigger demand overseas. That is quite a mistaken impression. Stocks were reduced at Barrow, and the fact that there was work for the rail department dictated the starting of the furnaces. If the Continent and America are requiring hematite pig iron—that is, if the industries abroad are in such a position as to require deliveries—then undoubtedly local iron producers should benefit, but it would be unwise to expect much, for it is well known that the iron and steel industries all over the world are not so placed as regards contracts as to need heavy tonnages. The stocks in this district are still fairly heavy, but the general demand, combined with the consumption on local steel account, should at present tend to bring stocks down. In the iron ore market there is a slightly better outlook, both on native and foreign account. The steel market is still quiet. Workington has got to work on railway material, including sleepers, and it has contracts to keep it going for a little more than a month. The Barrow Steel Works are starting, but the contracts are not heavy at present, although there may be further developments.

SHEFFIELD.

(From our own Correspondent.)

The General Position.

THERE is no present improvement in the state of the local trades, although hopes for the future are running high, and the shares of several companies—especially some which have been down to very low prices for a considerable time—have made progress on the Stock Exchange. The open-hearth basic steel trade is in a very poor condition, the demand for the material having weakened considerably since the Budget announcement, and having now reached the lowest level so far recorded. At Steel, Peech and Tozer's works—a branch of the great United Steel Companies—six furnaces are still being worked, but the difficulty of disposing of the output increases. The Park Gate Iron and Steel Works show a serious falling off, and now there are only two furnaces in commission out of nine, as against four a month ago. These works enjoyed much activity down to last spring, and were able to maintain a high output much longer than neighbouring establishments. A better report comes from Hadfields, who are busier than for a long time past, and appear to be an exception to the prevailing depression. In North Lincolnshire conditions are less favourable. A week or two ago one of the large works there had to suspend steel melting for want of orders, and although work has now been resumed its scale is restricted.

The Manufacturing Side.

The plants devoted to the manufacture of railway axles, tires, and springs are still badly off for work, although a few orders have been placed recently. The call for shipbuilding steel remains at a very disappointing level. The production of hollow forged drums for power stations and other large works continues to provide a fair amount of employment, but there is not much on hand in the way of heavy engineering. The firms which cater for the requirements of the automobile industry are turning out a substantial volume of products, but the demands upon them are still much below the normal. There is a well-maintained call for stainless steel and kindred materials. Trade in high-speed and other alloy steels has fallen to a low ebb, especially on the export side.

Looking Forward.

These special steels, however, should form one of the branches to benefit from the altered value of the pound sterling. There are many continental engineers who prefer the high-class Sheffield material, but it has been an expensive luxury for them in recent times of financial difficulty and high tariffs. Now, however, it will be cheaper to buy abroad. On the whole, Sheffield is expected to gain from the new financial conditions. Her goods will cost less to the foreign purchaser, while foreign goods sent here will be dearer, so that both the export and the home trade should benefit. On the other hand, there is the increased cost of raw material to consider. Iron and steel are imported from Scandinavia, and the better quality of steel-making ores from Spain and Morocco, and alloying metals are also imported. All these will be dearer. It is calculated, however, that, after paying the increased prices for their imported goods, our manufacturing industries will gain on balance. The iron and steel market shows improved activity. There are numerous inquiries, deliveries under contract are being increased, and there is a disposition to buy, especially hematite iron. Dealers in ferro-alloys also report a rather better inquiry.

A Company Report.

If anything were needed to show the urgent necessity for an improvement in trade, it is to be found in the reports of local companies on the past year's working. During the past few weeks I have referred to several of these reports, mostly of a depressing character, and there is another one this week which is no exception to that rule. This is the report of Thos. W. Ward, Ltd., a large firm prominently engaged in the iron and steel, shipbreaking, and many other industries. The directors speak of the abnormal times through which the iron and steel industry has been passing. Operations for the year were begun with stocks of raw materials, &c., at pre-war values, but owing to the unprecedented conditions which have arisen throughout the world, and the fact that prices have fallen below the lowest in living memory, the directors have been obliged to write down the stocks considerably. The year's operations have resulted in a loss of £62,795. A sum of £100,000 is to be transferred from reserve, and, after deducting preference and employees' dividends for the full year, which have already been paid, there is £31,892 to carry forward. The payment of the quarterly dividends on the preference shares, due on September 30th, has been postponed.

Cold-worked Steel Problems.

Valuable research work continues to be carried out in the department for the cold-working of steel and other ferrous metals, which was established at Sheffield University two or three years ago, and some interesting problems have been tackled during the past twelve months. The programmes have dealt with the drawing of wire suitable for ropes and springs, the rolling of strip suitable for pressing and the bright drawing of mild steel bars. An important point disclosed by an investigation of drawn wire for ropes is the unexpected variations in the hardness within the thickness of the wire, and it is hoped that further research will reveal the causes of some of the hitherto unexplained failures of wire ropes in service. The study of the drawing of wire has mainly taken the form of experiments to determine the best condition of drawing to obtain a high degree of resistance to fatigue. A special machine has been constructed, and this work will be continued. An investigation as to the amount of energy stored in cold-worked steel has occupied the entire time of one research worker, and will, it is hoped, be continued profitably. A report has been circulated among the manufacturers dealing with "stretcher strains" in deep pressings—which is one of the great difficulties with which the trade is faced—and it indicates a way to overcome the trouble. Search is being made for the best form of dies for different sections and qualities of steel. This is being done in conjunction with several important manufacturers, who have supplied their standard dies for the purpose. Such a wide difference in design is revealed that the department is making experiments to ascertain the most suitable type.

Cutlery and Plate.

There is nothing very much fresh to say about the cutlery and plate trades, which are for the most part unsatisfactorily employed. A few firms are able to report good order books, but they are in a minority. The trades are looking forward with hope, in consequence of the change in the value of sterling. A statistical report on the German cutlery industry in 1928, recently published, states that Germany has retained her pre-war position as chief exporter. Great Britain has lost her position as the second most important exporter, that place having been gained by the United States. It is also stated that the chief buyer of German cutlery is Great Britain. Evidently, there is ground for improvement here.

NORTH OF ENGLAND.

(From our own Correspondent.)

More Work for North-East.

THE industrial outlook in the North of England is distinctly brighter. Inquiries circulating in the iron and steel trade are larger and more numerous than they have been for a long time, and rather considerable contracts have been made this week. An encouraging feature is an increase in export business. Two North-East firms have received contracts for mining plant from Russia. Clarke, Chapman and Co., of Gateshead, have received a £100,000 order for mine boilers and haulage machinery, and the Birtley Iron Company, of Birtley, Durham, has secured a contract for coal-cleaning plant, which is to go to the Donetz Basin in Southern Russia. It will be the first installation of its kind in Russia, and it is expected that other contracts will follow. In addition to these orders, Vickers-Armstrongs recently received a £200,000 contract from abroad. The whole of this work, the nature of which has not been revealed, will be done at the Elswick Works, Newcastle. Sir William Gray and Co., West Hartlepool, have booked an order for two steamers for the West Hartlepool Steam Navigation Company. The vessels will be high-class cargo steamers and of about 8500 tons deadweight. Both will be fitted with quadruple-expansion engines, to be constructed at the Central Marine Engine Works, West Hartlepool. At the present time, the only berth occupied in the Hartlepools is at the dockyard, where the 9000-ton deadweight steamer ordered by R. Ropner and Co., early in July, is in course of construction. It is anticipated, however, that work will be started shortly on the 9000 tons steamer which the firm booked for T. and R. Harrison, London, about a month ago. The firm has now four orders for vessels of approximately 9000 tons each.

Cleveland Iron Trade.

Business is expanding on encouraging lines in the Cleveland pig iron trade. Producers are experiencing a better demand from Scotland, where imported iron has hitherto been a most formidable competitor. But the fact is that all consumers are now convinced that prices cannot fall, and may, not improbably, advance. Hence there is greater readiness to cover forward requirements, and a fair volume of orders has been placed. Producers are taking a firmer stand, but have not advanced the fixed prices. No. 1 Cleveland foundry iron is 61s., No. 3 G.M.B. 58s. 6d., No. 4 foundry 57s. 6d., and No. 4 forge 57s.

Hematite Pig Iron.

The heavy stocks of East Coat hematite pig iron promise to be appreciably reduced. Output is very small and recent sales have been relatively substantial. Home buyers are negotiating for forward supplies, and hematite consumers abroad are returning to this market. Several sales have been made to Germany, and a little business has been done with France and Scandinavia. Prices are sharply advancing. Coke is dearer, freights are up 1s. 6d.

per ton, and the fall in the exchanges will add to the cost of imported ores. Hence there is ample justification for an advance in hematite prices, which had fallen to an unremunerative level, and prompt sales have been made this week at 65s. per ton for mixed numbers, whilst still higher figures have been paid for deliveries up to the end of the year.

Iron-making Materials.

Variation in rates of exchange is responsible for discontinuance of quotations in foreign ore. Sellers refuse to name prices, and consumers are also off the market. Blast-furnace coke is plentiful, but sellers are adopting a firmer attitude. Consumers are buying little, but they are having to pay increased prices, and some producers will not sell below 16s. for good medium blast-furnace kinds delivered at the works.

Manufactured Iron and Steel.

There is rather more activity in one or two branches of the manufactured iron and steel trade, and prices are steadily upheld. A rise of 20s. in continental semi-finished materials may divert orders to this district. Dearer spelter has necessitated an advance in quotations for sheets. Galvanised corrugated sheets, 24 gauge, are now £9 10s.

The Coal Trade.

There is a brighter tone in the Northern coal market, but the position remains very unsettled and will do so until the sterling exchange becomes more defined. The action of Norway and Sweden in dropping the gold standard tends somewhat to neutralise the position for the coal trade between this district and those countries, and an advance in freight rates is also a pointer against any quickly increased volume of trade. Thus, whilst overseas buyers are sounding the market freely, they are not keen to put definite orders on shippers' books. Northumberland steams and best Durham bunkers are the best features at the moment. Best Northumberland steams are scarce, as many pits have been idle for the most part of this week, owing to the exhaustion of the quota. This circumstance has diverted trade to kindred collieries which had not disposed of their quarter's allowance. Prices are slightly firmer at 14s. to 14s. 3d. Tyne prime steams are moving more freely, and are rather steady at 12s. 9d. to 13s. for large, but unchanged for small at 9s. There is no diminution in the heavy stocks of steam smalls in Northumberland, and an improveed demand would be welcomed. The Durham gas coal trade shows little movement of special note. The position has remained practically unaltered for the past week or two. Buyers can cover at recent values. Best qualities are quoted at 14s. 6d., secondary at 13s. 6d., and special Wear qualities at 15s. The position of sterling is encouraging foreign owners to divert tonnage to this coast for bunker supplies, and numerous prompt orders are circulating. Best unscreened Durham bunkers are in demand and are quoted firmer at 13s. 6d. to 14s. 6d., but second qualities are plentiful and unchanged at 13s. 6d. Coking coals are also moving off more rapidly. In the coke section, ordinary classes of foundry coke are showing more activity at 16s. 6d. to 17s. 6d., and specials command up to 25s. Gas coke fully retains its strength at 19s. for bests, and at 18s. 6d. for seconds. Blast-furnace coke for home use is in no better demand, but producers are not keen to sell at 15s. as they have been, and some will not name below 16s.

SCOTLAND.

(From our own Correspondent.)

Note of Uncertainty.

Recent events have caused a feeling of uncertainty in all markets. Unsettled conditions are general since the suspension of the gold standard, although the change is received with a certain amount of complacency by those interested in the heavy industries. On the whole, it is believed that the export trade should move with greater freedom, and the probability of increased prices for imported materials has not so far, at all events, elicited any expressions of uneasiness. Though the monetary developments at home are received with equanimity, exporters on the whole are watching with keen interest movements abroad, and are disposed to act with extreme caution until more stable conditions are established.

Steel.

Operations in the steel market have been even more restricted during the past week, pending a steadying of exchanges. It is hoped that trade will ultimately benefit, but in the meantime steel makers are in need of orders for all products. Plates, sections, and structural materials are all very short of specifications. Steel sheets, too, are very neglected in both black and galvanised descriptions. Galvanised corrugated sheets are quoted £10 5s. home and about £9 10s. per ton export for 24 g. The tube trade is dull and without any encouraging feature.

Iron.

Progress in iron bars is very slow against competition at home and abroad. The home price is unchanged at £10 5s. per ton, but the current export quotation of £9 10s. might be shaded if a suitable specification came to hand. Re-rolled steel bars likewise are stagnant. For home delivery the price is £6, but export has weakened to £5 17s. 6d. per ton. Cast iron machinery scrap is easier at 46s. per ton.

Wages in the Iron Trade.

The average net selling price of manufactured iron during July and August last has been certified as £10 5s. 8·53d. per ton. This means that the wages of the workmen will be subject to a decrease of 2½ per cent. on basis rates.

Coal.

There is not much change in the Scottish coal market since last week. Home demands increase gradually as the days shorten, but otherwise business is on recent lines. There has been a little more inquiry on export account, but owing to fluctuating exchanges exporters have found some difficulty in making quotations. Colliery prices are more or less unchanged, but there is a tendency towards appreciation when forward business is mentioned. On the whole, round fuels are fairly plentiful at recent values. The smaller sizes of nuts are in good supply, and are inclined to weaken. Treble and double nuts in all districts are firm.

Pig Iron.

The volume of business in Scottish pig iron is very limited, and makers as a rule are supplying from stock. Only one furnace remains in blast, but there is some talk of increasing the output almost immediately in order to increase stocks for local purposes. Importations of pig iron into this district still continue, last week's figure amounting to over 2000 tons.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal and Allied Industries.

Conditions on the commercial side of industry, as they affect coal and iron and steel, are still very unsettled and it is evident that some time must elapse before anything like stability can be achieved. The fluctuations in exchange rates make it extremely difficult for operations to be conducted, and although the general outlook is better, it is early yet to say to what extent there is any real improvement. So far as coal is concerned, it can be said that there is an expansion in the inquiry from abroad, but while there are definite requests from continental consumers for quotations for supplies for delivery over various periods, it should be pointed out that it is quite possible that a fair percentage of the inquiries are somewhat in the nature of feelers. The abandonment of the gold standard and the effect which it has in enabling this country to compete better for the business that is available is, of course, causing no little amount of perturbation among continental producers, especially Germany, where owners are seeking for a reduction in the miners' wages and there is talk of the Government being compelled to subsidise the industry. In the case of Italy there has been one definite development since last week, and this is that the Italian Government has decided to impose a revenue duty on imported coal and coke to the extent of 10 per cent. on the c.i.f. value. This operates immediately, but does not apply to railway or bunker coals. Considering that the bulk of coals from this district are for railway and bunkering purposes, South Wales is not seriously affected by this new duty, and, further, seeing that the impost applies to all coal imported and not merely to that received from this country, no complaint can be made on the score of unequal treatment. While the outlook generally can be regarded as more promising, it is unwise to be too optimistic, and it must be admitted that at the moment the conditions as they concern steam coals leave much to be desired. Many collieries are still working very irregularly, as can be seen from the fact that at the end of last week the number of idle tipping appliances reached fifty-two, while as the result of arrivals of steamers over the week-end the position on Monday was that the number was reduced to thirty-eight, and there were only three vessels waiting to berth at Swansea. This was not a healthy position, and the chartering of tonnage is difficult because of the reluctance of owners to fix their tonnage until they can gauge the situation better. Shipments last week displayed no very material change, as the total was only 422,760 tons, which compared with 426,695 tons for the preceding week and with 539,047 tons for the corresponding period of last year. As a matter of fact, the question of tonnage and freight rates has called for more attention and interest than anything else during the past week. Exchange movements have, of course, quite upset ideas of rates, as compared with those prevailing a fortnight ago, and it is not surprising to find that with operating costs higher shipowners have held out for advanced rates of freight. Rates for practically all directions have improved from the shipowners' point of view, and may still go higher if there is to be an increased volume of business. For instance, tonnage has been fixed this week for Genoa at 6s. 3d., compared with 5s. a fortnight ago, and rates of freight for the French coasting and Bay trades have advanced 9d. to 1s. per ton. Those exporters who entered into c.i.f. sales prior to this country going off the gold standard are, of course, bound to suffer financially by reason of their having to pay a substantially higher rate of freight than they based on when they quoted for the business, but still one does not hear of any firms seeking to get out of their obligations.

French Pitwood Trade Dislocated.

Reference was made last week to the fact that trouble was being experienced by pitwood importers in getting French merchants to carry out their contracts, and that the loading of tonnage was being delayed. It certainly came as a shock when on Friday last the Cardiff and Bristol Channel Pitwood Importers' Association received a telegram from the president of the Bordeaux Syndicate of Pitwood Exporters that they maintained their request to be paid on the gold standard basis, and practically declined to load vessels. Members of the Importers' Association hurriedly met to consider the situation and sent a wire that the Association had read with amazement the telegram which amounted to a breach of each contract. The Association refused to consider any variation of the payment clause, and insisted upon the French exporters fulfilling their contracts, otherwise they must be held responsible for all loss and damage. Since then the Cardiff Chamber of Commerce has met and considered the position, and passed a resolution supporting the attitude of the Importers' Association. A later message received from Bordeaux states that the Bordeaux Syndicate of Pitwood Exporters has considered the attitude of the South Wales importers, and has proposed that the matter should be submitted to arbitration. It is reported that the French exporters have suggested that the Bordeaux Chamber of Commerce should act as arbitrators. It is scarcely likely that South Wales importers will agree to this rather humorous proposal. Meantime business in French pitwood is practically at a standstill. The pitwood market, in fact, is little more than nominal, though 26s. to 26s. 6d. is reported to be the basis upon which some sales have been effected.

Tin-plate Trade.

Conditions in the tin-plate trade are firmer and prices are approximately 15s. to 15s. 6d. basis I.C., f.o.b. South Wales. Official notification was given that the Ffrwdwyllt Tin-plate Works, Taibach, would reopen this week. These works are among the largest in the Taibach area, and have been closed down for about eight or nine months. It is hoped that their reopening will provide employment for 500 to 600 men. About 200 men were restarted at the Upper Forest and Worcester Steel and Tin-plate Works, Swansea, on Tuesday, when work was provided in the sheet mills. This department has only operated about eight months during the past two and a-half years.

Current Business.

The general tone of the steam coal market is brighter, but actual new business for prompt loading is still restricted and a number of collieries are far from being well placed. It is reported that some collieries are reluctant to quote for business for delivery ahead; but the probability is that they are very much in the minority. At the moment, prices are showing practically no change, and are for the most part at the minima. An improvement is looked for in the inland market, but so far it is slow to mature. Patent fuel and coke remain without any change, but pitwood has a firmer tone.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

Matterson, Ltd., of Rochdale, inform us that Mr. John J. King, of "Dun-Laoghaire," The Poplars, Washington, Co. Durham, has been appointed agent for the whole of their specialities for the counties of Durham and Northumberland.

James Hall and Sons, Ltd., announce that owing to ill-health, Mr. J. Campbell has retired from active management in the firm, but retains his seat on the board as consulting director. Mr. A. C. Fendick has joined the firm as managing director.

Pegson, Ltd., is the style of a new company which has been formed to acquire the road-making and quarry plant business hitherto known as Samuel Pegg and Son. In the near future, the firm will migrate to the town of Coalville, where extensive premises recently occupied by Stableford, Ltd., railway wagon builders, have been acquired.

Kincaid, Waller, Manville and Dawson make the announcement that the partnership as now existing between Sir Edward Manville, Sir Philip Dawson, Mr. A. E. Jackson, and Mr. H. G. Simmonds has just been dissolved. Mr. A. E. Jackson, one of the present partners, will, however, continue in practice on his own account, whilst retaining the name of the firm with the full approval of the present partners, at Abbey House, Victoria-street, Westminster, S.W. 1—telephone No. Victoria 0631. Mr. Jackson has been associated with the firm as partner for the past eleven years, and has devoted especial attention to power station design and railway electrification.

CATALOGUES.

J. Knight and Hale, Ltd., Denton, Manchester.—Catalogue No. 600, "Bates" products, which include oil engines, centrifugal pumps, &c.

British Mannesmann Tube Company, Ltd., 67, Queen Victoria-street, E.C. 4.—"British Mannesmann Steel Tubes for the Oil Industry."

Agricultural and General Engineers, Ltd., Aldwych House, Aldwych, W.C. 2.—Particulars of the Howard five-tine self-lift road scarifier.

Churchill Machine Tool Company, Ltd., Broadheath, Manchester.—Pamphlet U N V 7 on universal and turret universal grinding machines.

Ferranti Scholarship.—The 1931 award of the Ferranti scholarship—annual value £250, tenable for two years—has been awarded by the Institution of Electrical Engineers to W. G. Thompson, B.Sc., Armstrong College, Newcastle-on-Tyne.

The Junior Institution of Engineers.—Dr. Standen L. Pearce, C.B.E., M. Inst. C.E., M.I.E.E., M.I. Mech. E., has accepted the invitation of the Council to become President of the Institution in succession to Colonel Sir Henry George Lyons, F.R.S., D.Sc. His induction will take place at a meeting to be held at the Royal Society of Arts on Friday, December 4th, when he will deliver his address.

The Royal Metal Trades' Pension and Benevolent Society.—The eighty-third anniversary festival dinner will be held at Grosvenor House, Park-lane, London, W. 1, on Tuesday, November 24th, 1931, under the chairmanship of Sir Ernest W. Petter, M.I. Mech. E. Dinner tickets can be obtained from the offices of the Society—double ticket (lady and gentleman), 27s. 6d.; tickets for gentlemen only, 15s. each. Contributions in aid of the funds will be gratefully received by the chairman, Sir Ernest W. Petter, at 75B, Queen Victoria-street, London, E.C., or they may be sent direct to the Society's office, 195, Upper Thames-street, London, E.C. 4.

Parkerising and Bonderizing.—On Thursday, September 24th, the Pyrene Company, Ltd., entertained a party at luncheon in the Savoy Hotel, and afterwards took its guests to the works at Brentford, on the Great West Road, where a demonstration of Parkerising and Bonderizing was given. The former is a method of rust-proofing and is carried out by the immersion of the parts to be protected in a hot solution of Parco powder for about an hour. It acts by converting the surface of the metal into an insoluble phosphate, which is impervious to rust under ordinary atmospheric conditions. The object of Bonderizing is to produce on iron or steel a non-metallic coating which is an integral part of the metal itself, but is sufficiently absorbent to ensure permanent cohesion with an applied coating of paint, varnish, or enamel. The process consists in dipping the parts for about ten minutes in a hot solution of Bonderite powder.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
(1) Native	16/- to 20/6
(1) Spanish	16/- to 18/-
N.E. Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	—

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 8 6	—
No. 1 Foundry	3 12 0	—
No. 3 Foundry	3 9 6	—
N.E. Coast—		
Hematite Mixed Nos.	3 5 0	3 5 0
No. 1	3 5 6	3 5 6
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
Midlands—		
(a) Staffs.—	(*Delivered to Station*).	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 1 0	—
„ „ Foundry	3 6 0	—
(a) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(a) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. Coast—		
N. Lancs and Cum.—		
Hematite Mixed Nos.	3 15 6 (a); 4 0 6 (b); 4 5 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	9 10 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 5 0	—
Common Bars	10 10 0	—
Best Bars	11 0 0	—
Double Best Bars	11 10 0	—
Treble Best Bars	12 0 0	—
Lancs.—		
Crown Bars	9 15 0	—
Second Quality Bars	8 5 0	—
Hoops	12 0 0	—
S. Yorks.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
Midlands—		
Crown Bars	9 5 0 to 10 7 6	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 7 6 to 9 0 0	—
Gas Tube Strip	10 10 0 to 10 12 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 10 0	10 0 0
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ½in.	7 10 0	7 10 0
Sheets (Gal. Cor. 24 B.G.)	10 12 6	9 15 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
Manchester—		
Bars (Round)	9 7 6	—
„ (Small Round)	6 10 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	8 17 6	—
Sheffield—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	6 0 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
Midlands—		
Small Rolled Bars	6 10 0 to 7 0 0	—
Billets and Sheet Bars	5 2 6 to 5 10 0	—
Galv. Sheets, f.o.b. L'pool	9 5 0 to 9 10 0	—
(2) Staffordshire Hoops	9 10 0	—
(d) Angles	8 7 6	—
(d) Joists	8 15 0	—
(d) Tees	9 7 6	—
(d) Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 0 0	—

NON-FERROUS METALS.

Swansea—		
Tin-plates, I.C., 20 by 14	f.o.b.	14/6 to 15/-
Block Tin (cash)		122 10 0
„ (three months)		126 10 0
Copper (cash)		33 15 0
„ (three months)		35 7 6
Spanish Lead (cash)		14 8 9
„ „ (three months)		14 5 0
Spelter (cash)		12 12 6
„ (three months)		13 2 6
Manchester—		
Copper, Best Selected Ingots		41 0 0
„ Electrolytic		42 0 0
„ Strong Sheets		75 0 0
„ Tubes (Basis Price), lb.		0 0 10¾
Brass Tubes (Basis Price), lb.		0 0 9¼
„ Condenser, lb.		0 1 0
Lead, English		15 12 6
„ Foreign		14 5 0
Spelter		13 7 6
Aluminium (per ton—raw ingot)	£85	

FERRO ALLOYS.

Tungsten Metal Powder	2/4 per lb.
Ferro Tungsten	2/- per lb.

	Per Ton.	Per Unit.
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£25 0 0	7/-
„ „ 6 p.c. to 8 p.c.	£24 0 0	7/-
„ „ 8 p.c. to 10 p.c.	£22 10 0	6/6
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£35 0 0	10/-
„ „ „ 1 p.c. carbon	£39 0 0	12/-
„ „ „ 0·70 p.c. carbon	£41 0 0	13/-
„ „ „ carbon free	11d. per lb.	
Metallic Chromium	3/1 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
„ „ „	£11 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£10 10 to £12 scale 5/- per unit	
„ „ 75 p.c.	£10 to £17 scale 7/- per unit	
„ Vanadium	12/9 per lb.	
„ Molybdenum	4/2 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£210	
Ferro Cobalt	8/6 per lb.	

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	13/6
„ „ Ell	14/3
„ „ Splint	14/- to 15/9
„ „ Trebles	13/6
„ „ Doubles	13/-
„ „ Singles	10/-
Ayrshire—	
(f.o.b. Ports)—Steam	13/6
„ „ Jewel	17/-
„ „ Trebles	13/6
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	11/6 to 13/6
Screened Navigation	17/-
Trebles	15/-
Doubles	13/6
Singles	10/6
Lothians—	
(f.o.b. Leith)—Best Steam	10/9 to 11/-
Secondary Steam	10/6
Trebles	14/-
Doubles	13/- to 13/6
Singles	10/-

(8) N.W. Coast— ENGLAND.

	Inland.
Steams	21/-
Household	30/- to 51/-
Coke	20/- to 20/6
Northumberland—	
Best Steams	14/- to 14/3
Second Steams	12/- to 12/3
Steam Smalls	8/6
Unscreened	12/6 to 13/-
Household	27/- to 39/-
Durham—	
Best Gas	14/6
Second	13/3 to 13/6
Household	25/- to 37/-
Foundry Coke	24/-
Sheffield—	Inland.
Best Hand-picked Branch	24/6 to 25/6 —
South Yorkshire Best	23/6 to 24/6 —
Derbyshire Best Bright House	21/- to 22/- —
Best House Coal	21/6 to 22/6 —
Screened House Coal	19/- to 20/- —
Best Screened Nuts	18/- to 19/- —
Small Screened Nuts	16/6 to 17/6 —
Yorkshire Hards	17/- to 18/6 —
Derbyshire Hards	17/- to 18/6 —
Rough Slacks	9/6 to 10/6 —
Nutty Slacks	7/6 to 8/6 —
Smalls	5/6 to 6/6 —
Blast-furnace Coke (Inland)	10/- on rail at ovens
Furnace and Foundry Coke (Export), f.o.b., 14/- to 15/-	

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	19/6
Second Smokeless Large	18/9 to 19/6
Best Dry Large	18/6 to 18/9
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/-
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/- to 13/6
Ordinary Smalls	11/- to 13/-
Washed Nuts	18/- to 21/-
No. 3 Rhondda Large	19/9 to 20/-
„ „ Smalls	15/- to 16/-
No. 2 „ Large	17/- to 17/3
„ „ Through	15/6 to 16/-
„ „ Smalls	14/- to 14/3
Foundry Coke (Export)	22/- to 26/6
Furnace Coke (Export)	16/6 to 17/6
Patent Fuel	19/- to 19/9
Pitwood (ex ship)	26/- to 26/6
Swansea—	
Anthracite Coals:	
Best Big Vein Large	35/- to 37/6
Seconds	27/- to 31/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 45/-
Nuts	40/- to 46/-
Beans	24/9 to 28/3
Peas	21/- to 22/-
Breaker Duff	8/6 to 9/6
Rubbly Culm	8/6 to 9/-
Steam Coals:	
Large	20/- to 20/6
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 22/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/- if home consumers confine purchases from associated British Steel Makers. (e) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

The Trade Outlook.

THE depreciation of the pound has so completely changed the conditions of international trade that no one knows what is going to happen, and everyone is looking for means of defence against supposed difficulties and dangers. In such circumstances, business is necessarily at a standstill. So long as there was merely a prospect of an import tariff into Great Britain, steelmakers were assured that, with minimum prices on the home market, they could well support an expected 10 per cent. duty, but the sudden drop of the pound has, for the time being, raised a far more formidable barrier against the importation of steel and other products. The situation is made worse by the fluctuations of British currency, which do not enable buyers and sellers to make any arrangements for the future. Nothing can be done until the pound is stabilised. The only thing certain at the moment is that British prices abroad have fallen to a dangerously competitive level, and other countries are examining all kinds of methods to protect themselves from that competition. Not only is the international market paralysed by an impossibility to see what is going to happen in the immediate future, but all those countries which depended on the pound sterling find their purchasing power considerably reduced, and it would be futile to overlook the fact that while British goods may be offered cheaply, there is, over the greater part of the Continent, a serious restriction of buying capacity. It is only when the pound is stabilised that foreign countries will be able to adapt themselves to the new conditions. Meanwhile, there are evidences of higher protective tariffs, such as in Italy, where a super-tariff has been imposed, and of bounties for export, such as in Sweden where steel prices have been reduced 15 per cent., to the consternation of German steelmakers who fear that they are being eliminated from competition. When the pound is stabilised there will probably be a reorganisation of international trade.

Fuel Summary.

A conference of civil engineers was held last week at he Colonial Exhibition, and was addressed by Monsieur Charles Roux, who summarised the long series of meetings on national fuels. He stated that the conclusion come to was that the problem could only be met by utilising all the different fuels at home and in the colonies. No one fuel could be produced in sufficient quantity to supply all the needs. The fuels available might be divided into two categories, those that could be produced cheaply enough to replace imported fuels and those that were satisfactory in use, but were too costly and must therefore be reserved for purposes of national defence. Attempts to utilise peat and lignite had so far failed, because the peat in this country contained too much ash and the lignite had too high a content of sulphur. Shale oil was beginning to offer some promise of commercial success through the recent introduction of a method which allowed the oil to be produced and refined at a lower cost than by the Scottish process. That process was said to open up great possibilities for the deposits in the Franche Comté, which contained from 6 to 15 per cent. of oil, according to the depth, while there existed enormous reserves of shale extending from the Limburg in Belgium down to Besançon, containing more than 6 per cent. of oil and outcropping over a large area. The problems affecting alcohol were well known. They were, concluded Monsieur Roux, purely economical, and the compulsory use of alcohol as a motor fuel would absorb all that could be produced, to the benefit of the beet industry and of agriculture generally. A beginning is to be made by rendering compulsory a mixture of 30 per cent. alcohol with petrol for all commercial vehicles. The running of lorries and public service vehicles on this mixture during the time of the Congress has shown that it is not only satisfactory but that the fuel is superior in some respects to petrol alone. For the time being, however, the use of the mixture is only possible economically by the State supplying it at below cost. The commercial production of oil from coal has made little progress, but wood is being used more and more for lorry suction gas plants, for which purpose it is more economical than charcoal, provided it is sufficiently dry. The tar products are eliminated in modern generators. The problem of colonial fuels seems to have been solved by the wood suction gas plant, and by vegetable oils in solid injection engines. Methods must now be devised of producing vegetable oil cheaply on the spot, so as to get it below the cost of gas oil in the interior of the African colonies. It is concluded that by utilising all the different kinds of fuels available at home and in the colonies there will be little or no necessity to import fuels.

Coal.

On account of the commercial treaty between Belgium and Germany, which precludes the first-named country from imposing a limitation on the imports of German coal, it was hopeless for the Belgian Government to inaugurate a system of coal licences unless it secured the approval of the German coalowners. After long negotiations an arrangement has been come to whereby the coal imports from all countries will be restricted by 24 per cent. and the Belgian coalowners will reduce their production by 10 per cent., so that the total reduction will allow of the existing heavy stocks being absorbed during the next four months. It is reported that the licence system will come into operation on October 1st. The negotiations with Germany were hastened in view of the heavy fall in the foreign prices of British coal.

A Novel Strike.

There have been occasional strikes against wages reductions, but French operatives have rarely struck for a reduction in the hours of work, their object being generally to earn as much money as they can by working overtime. At La Rochelle last week a builder with urgent work in hand arranged with his men to make up for arrears caused by the bad weather by working ten hours a day. The inspector summoned the builder, whereupon the men protested against this encroachment on their liberty by going out on strike. This is not the first case of its kind that has happened.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

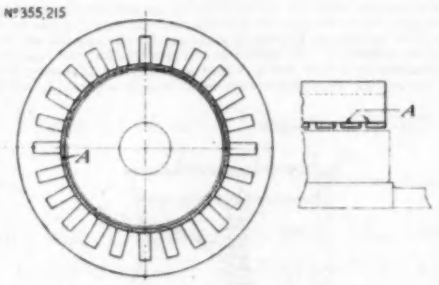
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

355,215. March 18th, 1930.—SLOTTED CORES FOR ALTERNATING-CURRENT DYNAMO-ELECTRIC MACHINES, Ateliers de Constructions Electriques de Charleroi, of 91, rue de l'Enseignement, Brussels, and of Charleroi, Belgium.

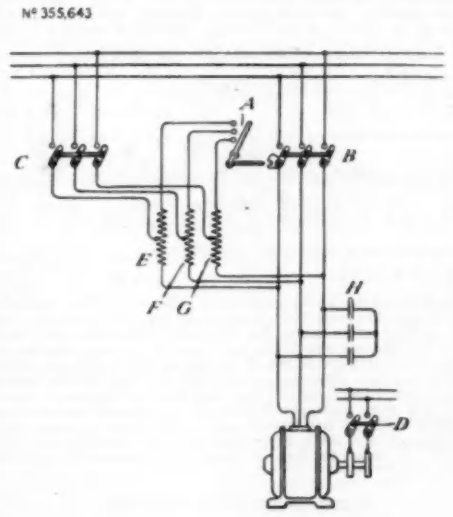
This invention relates to A.C. dynamo-electric machines, and more particularly to the construction of slotted stator cores for such machines, using slots of the "open" type, which facilitate



the work of stator winding. After the completion of the winding the open slots are closed by means of rings or annuli A introduced with a given tightness of fit into the stator. The rings are constituted by a number of smooth solid units, adapted to satisfy the conditions imposed and are introduced into the bore of the stator as a series of rings arranged end to end. The magnetic material constituting the rings must be judiciously selected in order to suit the conditions of operation.—*August 18th*, 1931.

355,643. February 11th, 1931.—METHODS OF AND MEANS FOR STARTING ELECTRIC MOTORS, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C.* 2.

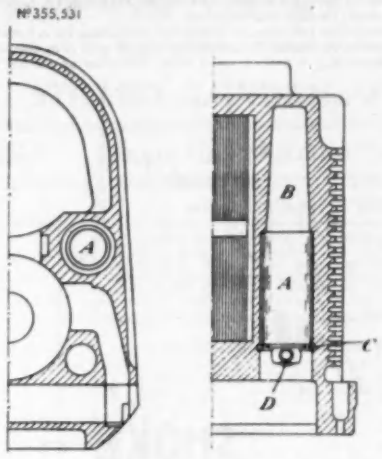
In accordance with this invention a starting compensator or auto transformer is used for applying an excess starting voltage to a synchronous motor with a squirrel cage starting winding, together with switching means whereby a winding of the compensator may be connected as a reactor in the motor circuit while the motor is switched from the excess starting voltage to the normal voltage. In the starting of the motor the switch A is closed, the switch B being open, to establish the "Y" connection for the auto transformer. The switch C is then closed to apply an excess voltage from the auto transformer to the motor. At this stage the switch D is open, so that the field of the motor will be de-energised. When the motor has accelerated to substantially synchronous speed on the excess voltage connections the switch D is closed to energise the field of the motor,



whereupon the motor will be pulled into step. The next step in the starting operation is the opening of the switch A, whereby the motor armature is connected to the supply source through portions of the windings E F G, which act as reactors, and while reducing the voltage applied to the motor somewhat, at the same time provide for sufficient voltage to hold the motor in step while the switch B is being closed, which is done as soon as possible after the switch A has been opened. The closing of the switch B connects the motor directly to the supply source for normal running conditions, and the compensator is thereafter disconnected from the supply source by opening the switch C. The object of the invention is to make relatively slow-speed motors start with a good starting torque and to prevent the motor slowing up and falling out of step whilst the change is being made from the excess voltage to the normal running voltage. The condensers indicated at H are for improving the power factor.—*August 27th*, 1931.

355,531. September 5th, 1930.—MOUNTING OF CONDENSERS IN IGNITION MAGNETOS, Fabbrica Italiana Magneti Marelli, of 22, Corso Venezia, Milan, Italy.

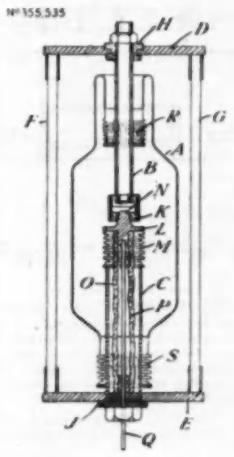
In accordance with this invention the condenser of a magneto is mounted in holes in the case provided for the purpose of reducing weight. In the drawing the condenser, which is of the circular type, is shown at A. Other holes for reducing the weight are provided in the case, but only one, such as that shown at B, serves to house the condenser, which is held in position by an expanding ring C fitting into a groove. The condenser elements are coiled so that the complete condenser forms a cylinder. One terminal is connected to the frame and is consequently "earthed," whilst the other projects at the outer end of the condenser, as shown at D.—*August 27th*, 1931.



SWITCHGEAR.

355,535. September 8th, 1930.—VACUUM ELECTRIC SWITCHES, International General Electric Company, Incorporated, of 120, Broadway, New York, U.S.A.

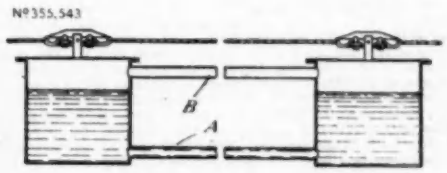
In high-power vacuum switches the vacuum vessel of which consists partly of glass and partly of metal, there is the danger of breakage, and the object of this invention is to overcome this trouble. The vacuum vessel A has two current leading-in members B and C firmly fixed into a frame consisting of discs D and E and rods of insulating material F G. The circuit to be opened and closed can be connected at H and J. The current leading-in member B carries a contact K, whilst the current leading-in member C is connected in a vacuum-tight manner with a contact plate L through a bellows M. The contact plate L has a conical projection N, which, on the switch closing, is pushed into the counter contact K. The leading-in member C accommodates strands O and P forming an additional conductive connection between the contact L and the terminal portion J. To the contact L a rod Q is fixed and is led outwards through an opening provided in the connecting terminal J, and serves for transmitting the switching movement to the contact L. The current leading-in members B and C are connected in a vacuum-tight manner with the vacuum vessel through strong bellows R and S. The bellows are so dimensioned as to withstand the external atmospheric pressure and to give the vacuum vessel A sufficient movability. The current leading-in member B is provided with a thread which serves for subsequent accurate adjustment of the contacts. Under the action of the external atmospheric pressure, which loads the lower side of the contact plate L, the switch closes automatically, whilst for the purpose of disconnection a switching mechanism of any construction is provided on the switching rod Q. If the atmospheric pressure acting on the contact plate L is too great, the pressure on the plate can be reduced to the necessary degree by suitable means, for example, by arranging a spring or providing a pressure below atmosphere in the tube C.—*August 27th*, 1931.



TRANSMISSION OF POWER.

355,543. September 17th, 1930.—OSCILLATION DAMPERS FOR OVERHEAD LINES, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

In order to reduce the injurious effects of the oscillations of electric overhead lines caused by the wind, one or more containers are freely suspended on the line and contain a movable substance, such as, for example, a liquid, the movements of which are utilised for damping the oscillations exerted on the

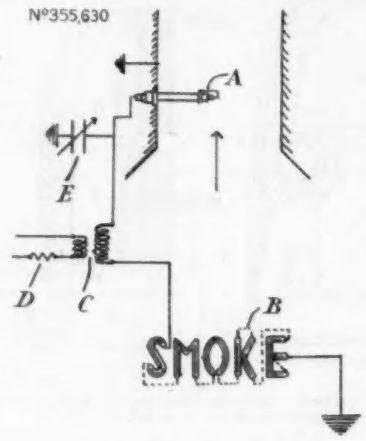


containers. The containers are connected together by a lower liquid tube A and an upper air tube B, which may, if necessary, consist of flexible pipes. The containers are charged with a viscous liquid. If the line begins to oscillate then the liquid level in the two connected containers also oscillates, the tube B permitting an equalisation in pressure of the enclosed air. The damping of the movement of the liquid causes dissipation of the energy and damping of the oscillations of the line.—*August 27th*, 1931.

MEASURING AND TESTING INSTRUMENTS

355,630. December 31st, 1930.—Apparatus for the Detection of Smoke from Furnaces, F. Trafford, 10, Lochhead-avenue, Denny, Stirlingshire.

The inventor proposes to warn the attendant on a furnace of the emission of smoke by arranging a spark gap A in the uptake and connecting it with a neon tube indicator as shown at B.

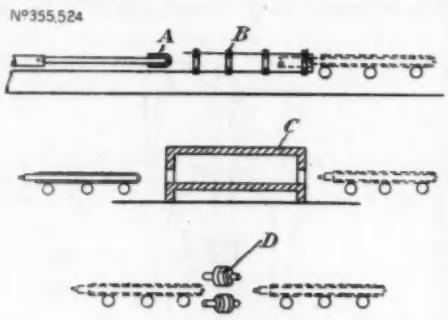


The spark gap and tube are supplied with high-tension electricity by the transformer C, while a resistance D prevents a heavy surge of current in the event of accident on the high-tension side. A condenser E maintains the electrodes of the spark gap at approximately the critical voltage at which an increase in the smoke density of the gases will permit the passage of current and thus illuminate the warning sign.—*August 27th*, 1931.

MACHINE TOOLS AND SHOP APPLIANCES.

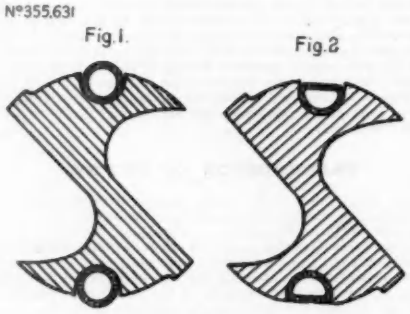
355,524. September 4th, 1930.—The Manufacture of Metal Tubes, Wellman Seaver Rolling Mill Company, Ltd., Victoria Station House, Westminster, and R. Hutchison, 108, Wellington-road, Bilston, Staffs.

It is suggested in this specification that solid-drawn tubes, made by the pushing process, may be spoiled in the final planishing or reeling on account of lack of heat. So the inventors push the billet A through the dies B for its rough formation and pass it on to a furnace C, where it is rapidly reheated to a temperature of about 1100 deg. Cent.—so rapidly that there is not time for the heat to penetrate to the mandrel within. The tube is then passed on to the reeling and planishing rolls D and is finally stripped off the mandrel.—*August 27th*, 1931.



355,631. January 1st, 1931.—Twist Drills, R. Stock and Co., Spiralbohrer-Werkzeug- und Maschinenfabrik A.G., Marienfelde, Berlin.

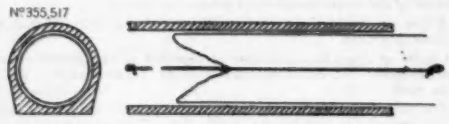
This invention relates to drills having inlaid pipes for the passage of cooling liquid to the cutting zone. It is suggested that the usual system of soldering the pipes into grooves in the drill is unsatisfactory, so the inventors secure them in the grooves by overlapping portions on the drill. The grooves are preferably made somewhat shallower than the diameters of the oil pipes, and the parts of the pipes projecting beyond the surface of the drill are pressed in until they are level with or even slightly below the surface of the drill. In this manner the oil pipes are made to conform to the shape of the grooves, and become firmly pressed against the walls thereof, resulting in an extremely intimate union of the oil pipes with the drill. The grooves are not quite as deep as the diameter of the oil pipes—see Fig. 1. The part of the oil pipe projecting beyond the surface of the drill is depressed so that the pipes are made to conform to the shape of the grooves and are firmly pressed against the walls thereof—Fig. 2, upper pipe. The edges of the groove are also worked down so that they overlap or engage over the oil pipes, thus securely retaining them in the grooves. The working down of edges and oil pipes may be effected successively or together in one operation.—*August 27th*, 1931.



BUILDING.

355,517. August 29th, 1930.—Apparatus for Casting Cement Pipes, Société "Satujo" Société Anonyme de Construction de Tuyaux Sans Joints, 40, Avenue de la Bourdonnais, Paris.

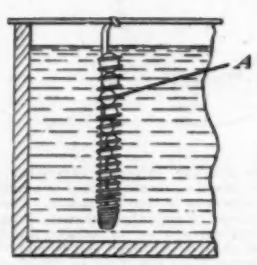
This invention is concerned with the laying of concrete pipes and especially with the core necessary for casting them *in situ*. No mention is made of the exterior forms, but it is suggested that lengths of from 50 m. to 100 m. can be made in one operation, while diameters of from 5 mm. to 1 m. can be used. The core takes the form of a tube of flexible impervious material, which is inflated by air or water. When the length of pipe has been poured the core is deflated and is pulled out, inside out, by a rope attached to the front end. It can then be rearranged for a repetition of the process by an outward extension of the rope. A sheet metal ferrule is used to connect the successive lengths of pipe together, being embedded in the concrete.—*August 27th*, 1931.



MISCELLANEOUS.

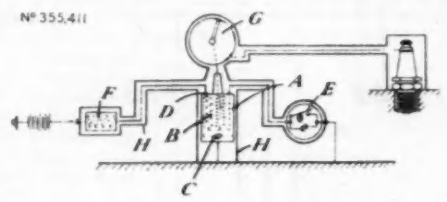
354,939. June 30th, 1930.—Anodes for Electro-plating, *Udylite Process Company, of* 3220, *Bellevue-avenue, Detroit, Michigan, U.S.A.*

The anodes used for electro-plating in accordance with this invention are in the form of spheres, and the object of the invention is to provide an improved container for the anodes which is easy to construct. As shown in the illustration, the container A consists of a wire helix, which is composed of heavy wire. At the top the convolutions are fairly widely separated, but the distance between the turns is decreased as the lower end is approached. The type of anode is employed primarily for electro-plating in baths composed largely of the double cyanide of sodium and potassium and another metal, and usually containing an appreciable proportion of free cyanide. In such a bath the helical wire container may be composed of steel. In the case of other baths, such as acid baths, the anode container may be constructed of a different metal, such as lead. The size of the anode balls to be employed depends upon the nature of the metal which is being deposited.—*August 20th*, 1931.



355,411. June 14th, 1930.—Battery Ignition Apparatus, Robert Bosch Aktiengesellschaft, of 4, Militärstrasse, Stuttgart, Germany.

As is well known, the ignition devices of internal combustion engines cause considerable interference during the reception of wireless messages, especially when both the ignition and wireless apparatus operate in adjacent regions. This interference is particularly noticeable in connection with aircraft, and the object of this invention is to overcome the difficulty. As shown in the drawing, the whole ignition apparatus is enclosed on all sides in an earthed metal covering. Within a casing A is the induction coil B with the condenser C. The end D of the primary coil nearest the battery is connected through the condenser C to the earthed metal casing A. The usual connection leads pass from the ignition coil to the interruptor E, the series resistance F and the distributor G, from which the ignition cables run to the sparking plugs. The connection leads and the ignition cables are placed in metal tubes which form a part of the metal cover H. The series resistance F between the primary coil and the battery cable of the battery acts both as a resistance and inductance, and its inductive action helps to lead off high-frequency waves through the condenser C to earth.—*August 27th*, 1931.



Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

TO-DAY.

Institute of British Foundrymen: Sheffield and District Section.—Albany Hotel, Sheffield. Presidential address, "Founding Through the Ages," by Mr. G. C. Castle. 7.45 p.m.

Institution of Chemical Engineers.—Chemical Society's Rooms, Burlington House, Piccadilly, London, W. 1. Paper, "The Gas Generator as a Direct Producer of Metallurgical Products," by Messrs. N. E. Rambush and F. F. Rixon. 6 p.m.

Iron and Steel Institute.—Autumn Meeting at Swansea. For programme see pages 105 and 255.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Lecture, "Reinforced Concrete in India," by Mr. R. P. Mears. 7.30 p.m.

SATURDAY, OCTOBER 3rd.

Institute of British Foundrymen: Lancashire Branch.—College of Technology, Sackville-street, Manchester. Paper, "Low Total Carbon Cast Irons and their Service to the Foundryman," by Mr. W. West. 4 p.m.

MONDAY, OCTOBER 5th.

Bradford Engineering Society.—In the Technical College, Great Horton-road, Bradford. Address by the President, Mr. W. Hiles, followed by a film, "Cable Making and Pylon Construction." 7.30 p.m.

Society of Chemical Industry: London Section.—In the Chemical Society's Rooms, Burlington House, London, W. 1. "Recent Applications of Science to Agriculture," by Sir Daniel Hall, F.R.S. 8 p.m.

TUESDAY, OCTOBER 6th.

Institution of Heating and Ventilating Engineers.—At Swedenborg Hall, 20, Hart-street (entrance in Barter-street), Bloomsbury, London, W.C. 1. "Exhaust Ventilation in Asbestos Textile Works," by Mr. Chas. W. Price. 6.45 p.m.

Staffordshire Iron and Steel Institute.—At the Education Offices, St. James'-road, Dudley. Presidential address, "Modern Trend in Cast Iron," by Mr. R. P. Bethell. 7 p.m.

WEDNESDAY, OCTOBER 7th.

Institute of Fuel.—In the Lecture Theatre of the Institution of Electrical Engineers, Victoria Embankment, W.C. 2. Joint meeting with eighteen other institutions. "Coal: Smokeless Fuel and Oil from the National Standpoint," by Dr. W. R. Ormandy. 7 p.m.

Institution of Mechanical Engineers: Yorkshire Branch.—In the Mining Department of University of Sheffield. "Mechanical Aspects of Coal Face Machinery," by Professor I. C. F. Statham. 7.30 p.m.

THURSDAY, OCTOBER 8th.

Institution of Structural Engineers.—10, Upper Belgrave-street, S.W. 1. "The Influence of Rapidly Alternating Loading on Concrete and Reinforced Concrete," by Dr. E. Probst. 6.30 p.m.

Royal Aeronautical Society.—Lecture postponed.

FRIDAY, OCTOBER 9th.

Chemical Engineering Group.—Chemical Society's Rooms, Burlington House, Piccadilly, London, W. 1. Paper, "The Manufacture and Testing of Asphalt Paving Material," by Mr. D. M. Wilson. 8 p.m.

Institution of Production Engineers: London Section.—In the Council Room of the Society of Manufacturers and Traders, 83, Pall Mall, S.W. 1. Annual general meeting. 7 p.m. "Distribution and Production," by Mr. J. G. Young. 7.30 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. "Office Engineering," by Mr. Edwin D. Gill. 7.30 p.m.

WEDNESDAY, OCTOBER 14th.

Institution of Engineering Inspection.—In the Rooms of the Royal Society of Arts, John-street, Adelphi, London, W.C. 2. "Some Applications of Condensers to Electric Power Circuits," by Mr. P. R. Coursey. 5.30 p.m.

Newcomen Society.—Lecture Theatre of the Science Museum, South Kensington, London, S.W. 7. Presentation of short papers. 5.30 p.m.

THURSDAY, OCTOBER 15th.

Institution of Mechanical Engineers.—Annual dinner. Postponed.

FRIDAY, OCTOBER 16th.

Institution of Mechanical Engineers.—Storey's-gate, Westminster. Special General Meeting. By-laws. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Informal meeting. "The Characteristics of Commercially Pure Iron," by Mr. C. C. Berger. 7.30 p.m.

Overhead Lines Association.—At the Georgian Restaurant, Harrods, Ltd., Knightsbridge. Conversazione and Supper-dance. 8 p.m. to midnight.

University of London.—At the Institution of Electrical Engineers, Victoria Embankment, London, W.C. 2. Advanced Lecture in Engineering, "The Measurement of Light: Its Basis and its Significance," by Mr. E. C. Crittenden. 5.30 p.m.

West of Scotland Iron and Steel Institute.—Royal Technical College, George-street, Glasgow. Presidential address by Mr. John Bird. 7.15 p.m.

WEDNESDAY, OCTOBER 21st.

Institute of Fuel.—At the Connaught Rooms, Great Queen-street, London, W.C. 2. Annual dinner and dance. 6.45 for 7.15 p.m.

Institution of Production Engineers: Birmingham Section.—Grand Hotel, Birmingham. "Control of Factory Production," by Mr. T. G. Heckles. 7 p.m.

THURSDAY, OCTOBER 22nd.

Institution of Electrical Engineers.—Victoria Embankment, London, W.C. 2. Presidential address by Captain J. M. Donaldson. 6 p.m.

FRIDAY, OCTOBER 23rd.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, S.W. 1. Presidential address by Lieut.-Colonel E. Kitson Clark. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Informal meeting. "Some Instruments Used in Connection with Power Plant," by Mr. I. Fagelston. 7.30 p.m.

MONDAY, OCTOBER 26th.

Institution of Mechanical Engineers: Graduates' Section.—Storey's-gate, St. James's Park, S.W. 1. "The Manufacture of Wire," by Mr. W. W. S. Robertson. 6.45 p.m.

FRIDAY, OCTOBER 30th.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, S.W. 1. Informal meeting. Discussion on "Engineering in Agriculture," to be introduced by Mr. R. Borlase Matthews. 7 p.m.

Institution of Mechanical Engineers: East Midland Branch.—University College, University Park, Nottingham. Chairman's address, "The Importance of Metallurgy to the Engineer," by Professor C. H. Bulleid. 6.30 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. "Automatic Combustion Control," by Mr. S. J. Clifton. 7.30 p.m.

SATURDAY, OCTOBER 31st.

Institution of Production Engineers.—Grand Hotel, Birmingham. Annual dinner. 7 p.m. for 7.30 p.m.